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HOVERMAP FOR CONSTRUCTION

A COMPLETE SOLUTION: LIDAR MAPPING + AUTONOMY

A COMPLETE SOLUTION: LIDAR MAPPING + AUTONOMY

Provides advanced autonomy and mapping when drone-mounted, or can be used as a stand-alone mobile mapping system in any non-GPS environments

HOVERMAP MAPPING

Mobile Mapping

- Provides SLAM*-based mobile mapping
- Carry Hovermap or mount it to a drone or vehicle
- Use with our backpack, cage or vehicle mount accessories

HOVERMAP PLUS

Line-of-sight Pilot Assist drone operations

- LiDAR-based omnidirectional collision avoidance
- GPS-denied position hold and velocity control
- Enables safe line-of-sight flight indoors, underground or close to structures

HOVERMAP AUTONOMY

Beyond Line-of-sight flight through autonomous waypoints

- Enables beyond line-of-sight autonomous flight in GPS-denied environments
- Live 3D map streamed to tablet
- Tap-to-Fly: set smart waypoints using the live map

*SIMULTANEOUS LOCALIZATION AND MAPPING

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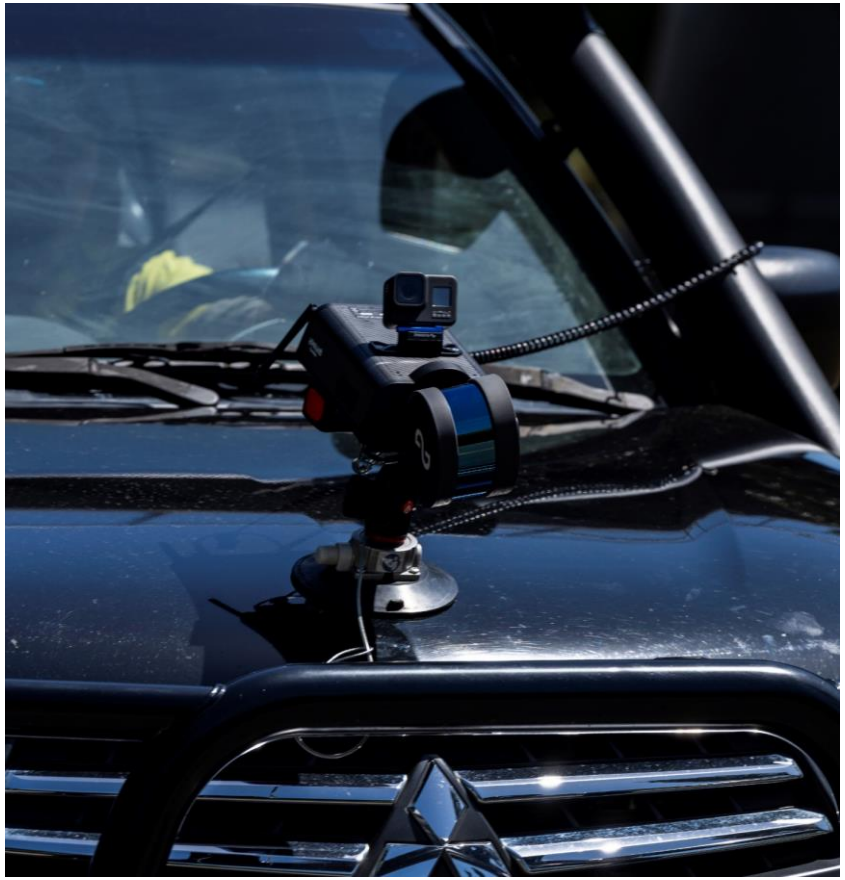
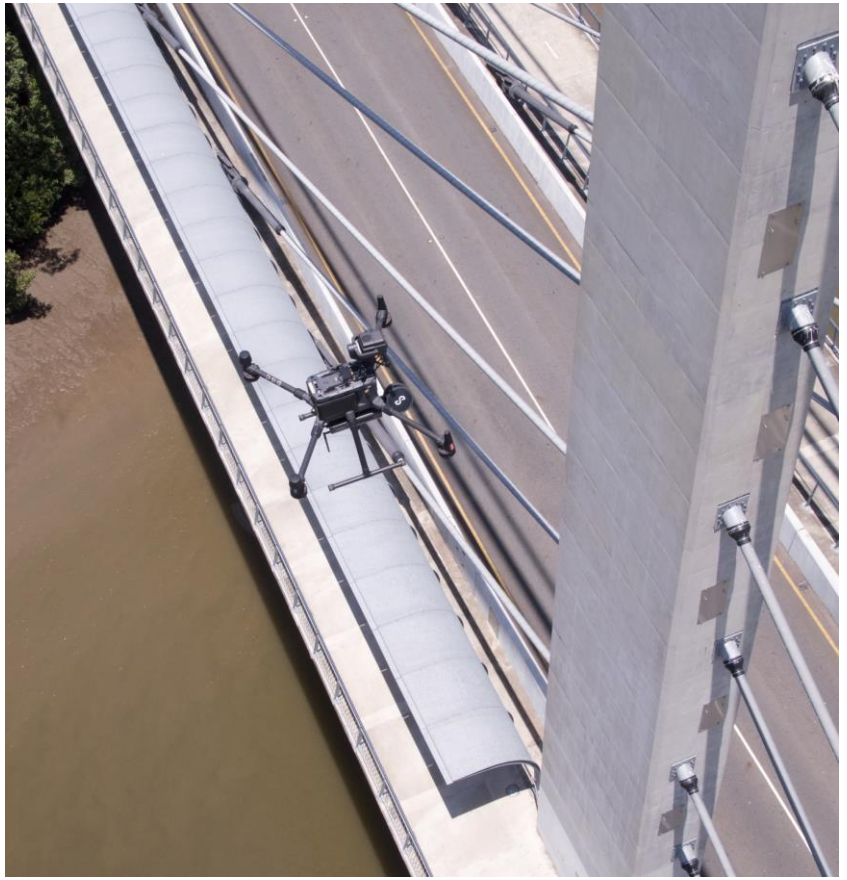
VERSATILE DATA CAPTURE

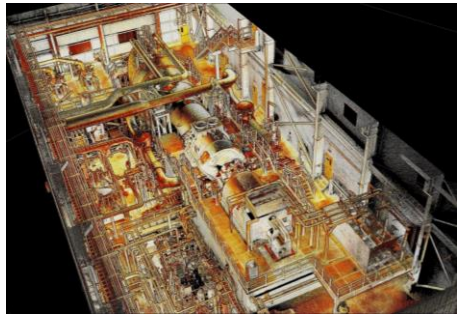
- Walking + vehicle + drone scans



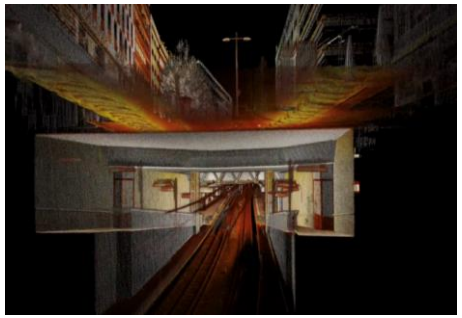


INDUSTRY USE CASES

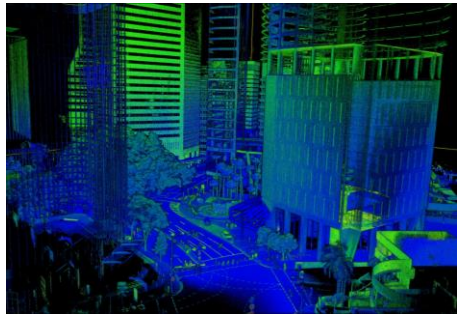
INDUSTRIAL INFRASTRUCTURE



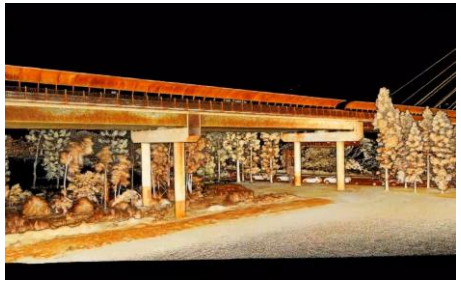
UNDERGROUND TRANSPORT



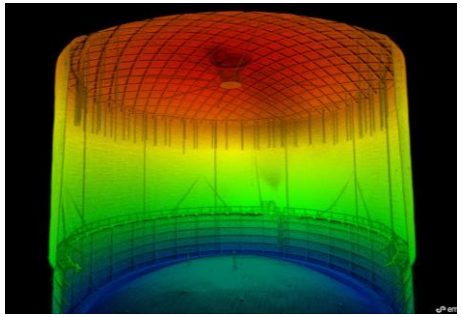
URBAN MAPPING



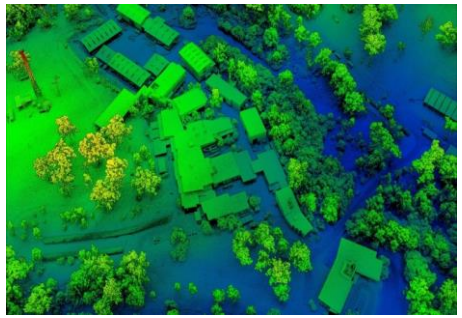
BRIDGE INSPECTION



OIL & GAS

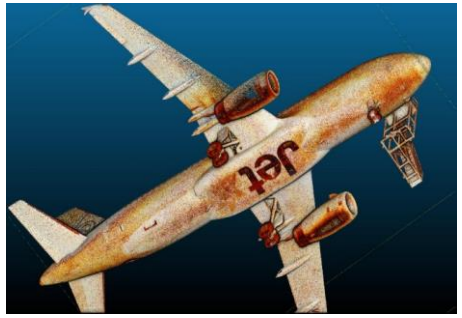


TERRAIN MAPPING

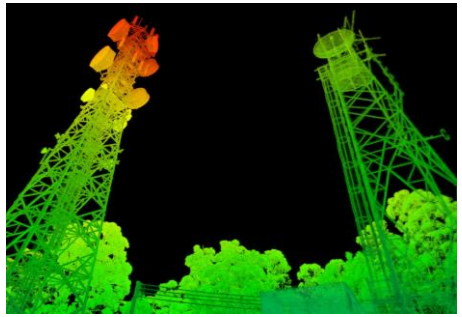


INDOORS

COMPLEX ASSET DIGITIZATION



TELECOMMUNICATIONS TOWERS



Applications

- Asset inspection
- Condition monitoring
- Rehabilitation and Maintenance
- As-built verification – QA/QC
- Deflection & geometric alignment
- Digital twin
- Design and planning
- Change Detection

INDUSTRY CHALLENGES

DATA MANAGEMENT:

- Legacy IT Systems
- Paper Based Records
- Disparate data sources

PERSONNEL:

- Manpower Shortage
- Working in hazardous/confined environments

INEFFICIENCIES:

- Mitigating costly unplanned downtime
- Inefficiencies – set-up, pack-up time

DATA CAPTURE:

- Complex assets
- Capturing Data not possible in certain locations
- Minimal autonomy in GPS denied environments

COMPETITIVE PRESSURES TO BE MORE PRODUCTIVE, EFFICIENT, GROW REVENUE AND STAY COMPLIANT

LACK OF DIGITAL TOOLS TO BE RELIABLE & SAFE

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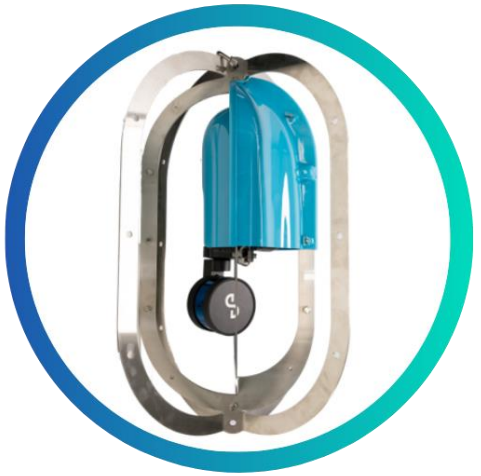
WHY HOVERMAP

KEY BENEFITS

ONE SYSTEM, MULTIPLE USES

Faster return on investment

- Ease of use – quickly deploy to site on vehicle, backpack, robot, tether, cage
- Combine multiple scans (indoors & outdoors)
- Easy technology adoption – minimal training required and simple workflows



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CAPABILITY COMPARISON

Metrics	TLS	Cart Lidar	Backpack	Drone LiDAR	Hovermap (SLAM)
Accuracy	**High**	**Medium**	**Medium**	**Medium**	**Medium**
Flight-Capable	**No**	**No**	**No**	**Yes**	**Yes**
Mobility	**Low**	**Low**	**Medium**	**Low**	**High**
Color Imagery	**High**	**High**	**Medium**	**Medium**	**High**
Speed to Data	**Slow**	**Slow**	**Medium**	**Medium**	**Fast**
Scanning Methods	**Single**	**Single**	**Single**	**Single**	**Multi** (drone, walking, vehicle, tether, boom)
Point cloud quality (noise and accuracy)	**High**	**Low**	**Medium**	**Low**	**Medium**

TIME SAVINGS

- **Rapid scanning / data capture:**
  - Easily deploy—walk, fly, or drive—in a few minutes
  - Coverage of large areas in one flight
  - 360-degree FOV coverage
  - Faster reality capture than photogrammetry
  - Better penetration of foliage than photogrammetry
  - No static SLAM calibration—start your scan immediately
  - Reduced asset downtime and loiter time

- **Fast access to your data:**
  - Real-time data visualization: view as you collect
  - Onsite processing: process and view in the field
  - Access high resolution point clouds in a few minutes, not hours or days (1:1.5 scan/processing time ratio)
  - Low-noise point clouds for fast classification of features

- **Continuous scanning:**
  - System can be moved from one carry system to another without interrupting the scan
  - One dataset reduces processing time in merging
  - Efficient mapping of the area

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ACCURATE MAPPING

- **High resolution data capture and point cloud density**
  - Identify detailed features with greater confidence
- **Shadowless, 100% coverage scans**
  - Accurate measurements, volumetrics or other analyses
  - Point clouds automatically merged at areas of overlap
  - Form complete digital twins of the mapped target

Mapping accuracy:

+/- 20mm in general environments

+/- 15mm in typical underground and indoor environments

+/- 5mm for close range scanning

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MAPPING IN GPS-DENIED ENVIRONMENTS

- **Greater coverage and insights:** Map inaccessible areas (bridges, buildings, plant rooms, roof areas, manufacturing areas, tunnels, vertical infrastructure)
- **No GPS required**: world class SLAM technology
- **Improved safety:**
  - Keep employees away from critical infrastructure (power lines, bridges, telecom towers, wind turbines)
  - Collision avoidance protects people, assets and equipment. Ability to get up close safely – no need for powerful camera to zoom in.
- **Ease of use:** no need to be an expert pilot. Single operator for the drone/camera, etc.

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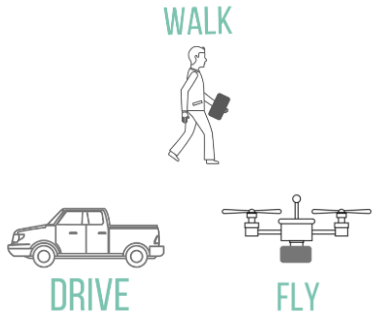
END-TO-END SOLUTION

1



CAPTURE

Fast, versatile data capture

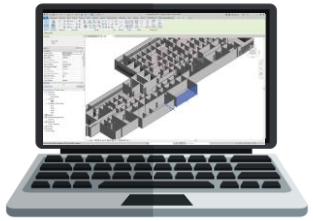
2

PROCESS

Process data

x1.5 capture time

3



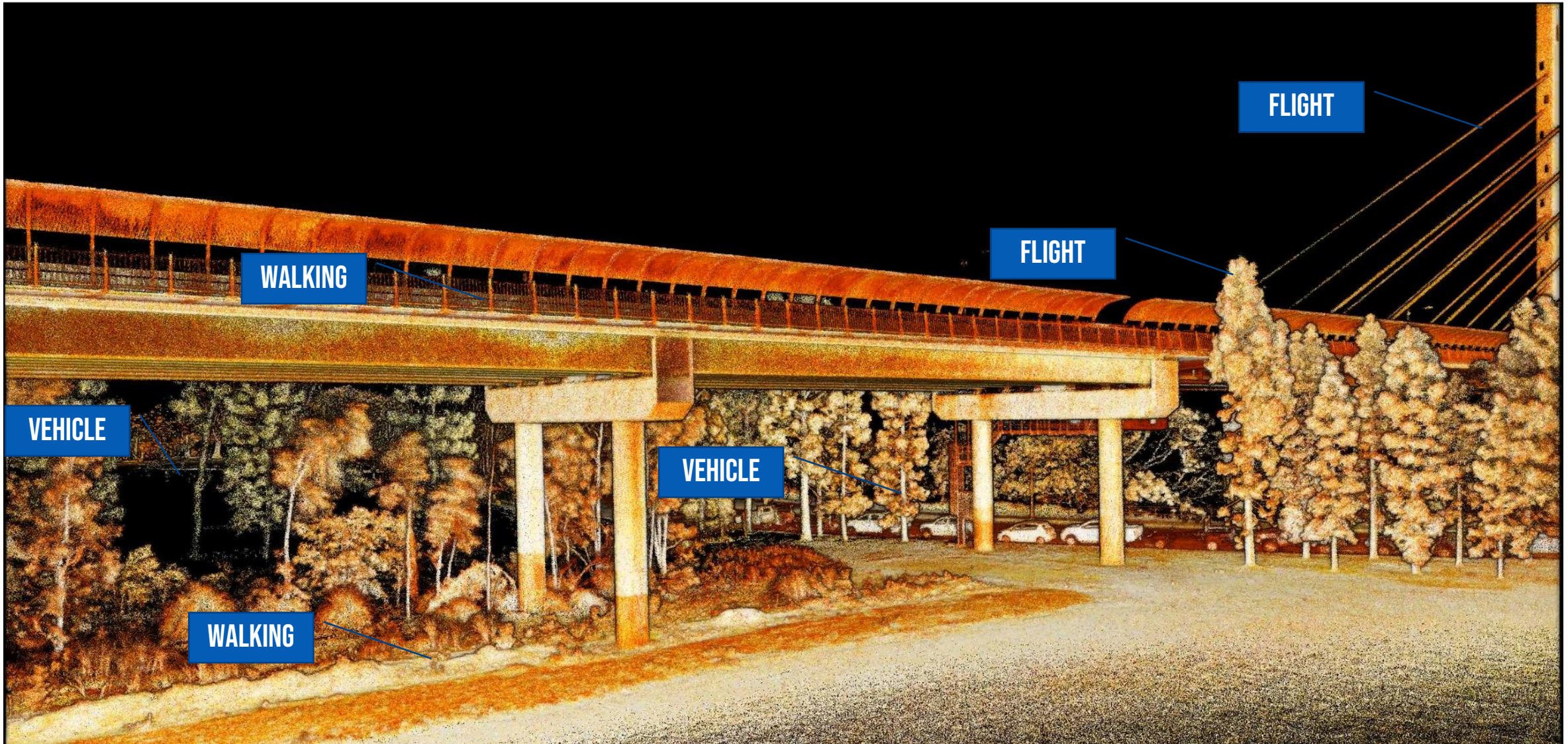
CONSUME

Create 3D designs

PointFuse, PointCab, Revit, etc

- Create mesh model.
- Classification
- Outputs:
  - Parametric BIM model (2D floor plan, 3D model)
  - Topographical map for environmental review
  - Digital twin
  - Colorized flythrough
  - Reports

ONE DELIVERABLE – MERGE MULTIPLE SCANS



RETURN ON INVESTMENT

- **No specialized technical equipment required** to achieve localized scanning requirements
- **One mobile mapping unit adaptable** to any data capture method (walk, drive, tether, fly)
- **Low operating costs:**
  - One person with basic training can capture data
  - Versatile platform suitable for multiple mapping applications
- **Upgradeable hardware platform:**
  - Long term capital benefit with reduced risk of short-term technology investment
  - Provides lower capital entry point if required
  - Simple add-ons to enhance features and capabilities

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CASE STUDIES

REAL-LIFE APPLICATIONS

STEAM TURBINE SCAN

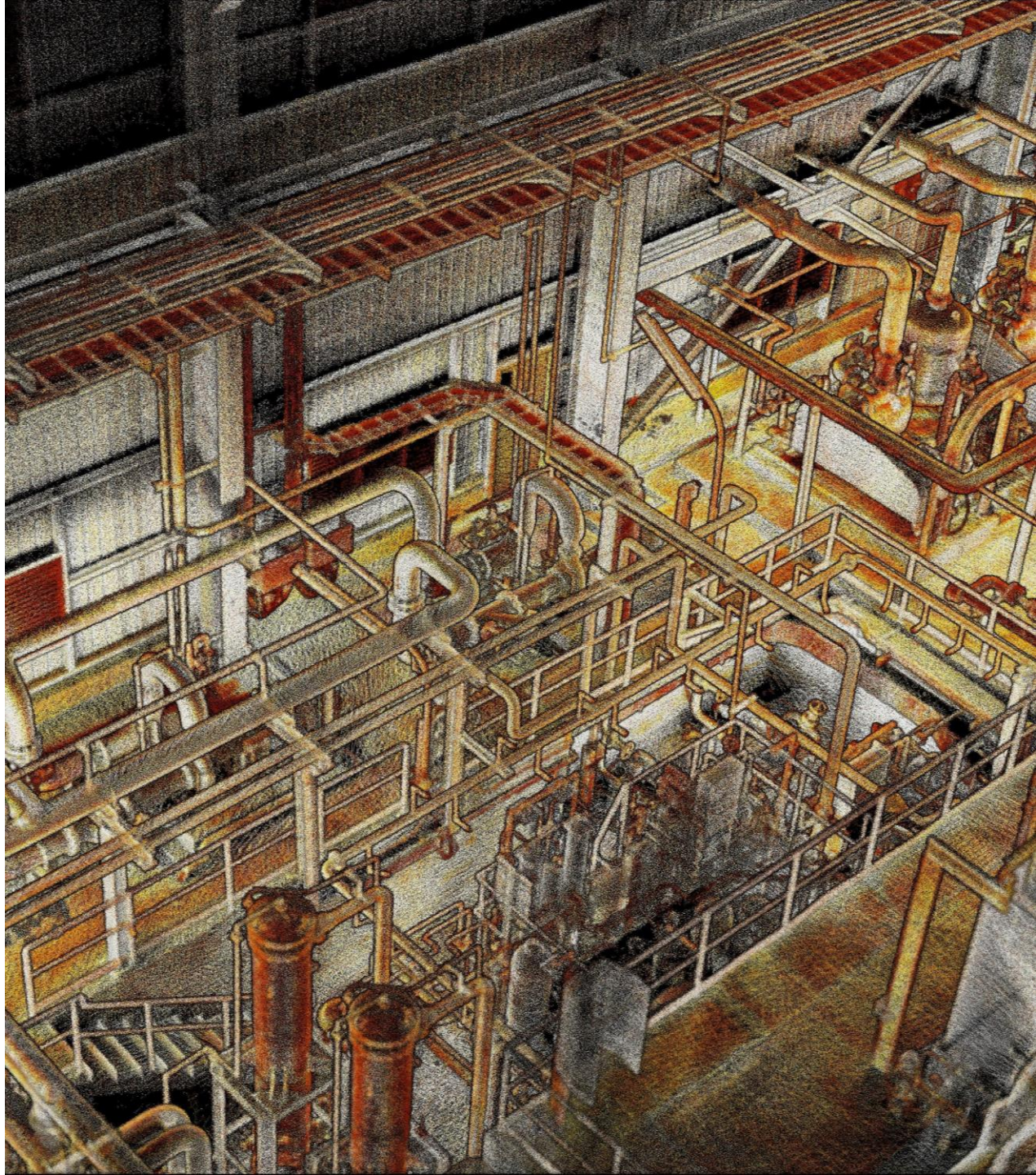
- Pertamina Geothermal Energy
- Kamojang, Indonesia
- 30 minute walking scan

The scan was processed into a CAD model, which was used to update the as-built drawings and schematics. This ensures the information on the asset is kept up to date for upgrades and maintenance.

“As-built drawings can be updated quickly and cost-effectively, with wide-ranging applications for operations and maintenance throughout the company's significant portfolio of brownfield production assets.”

Eli Moselle, CEO, Halo Robotics

HALO ROBOTICS



HYDRO STATION TUNNEL SCAN

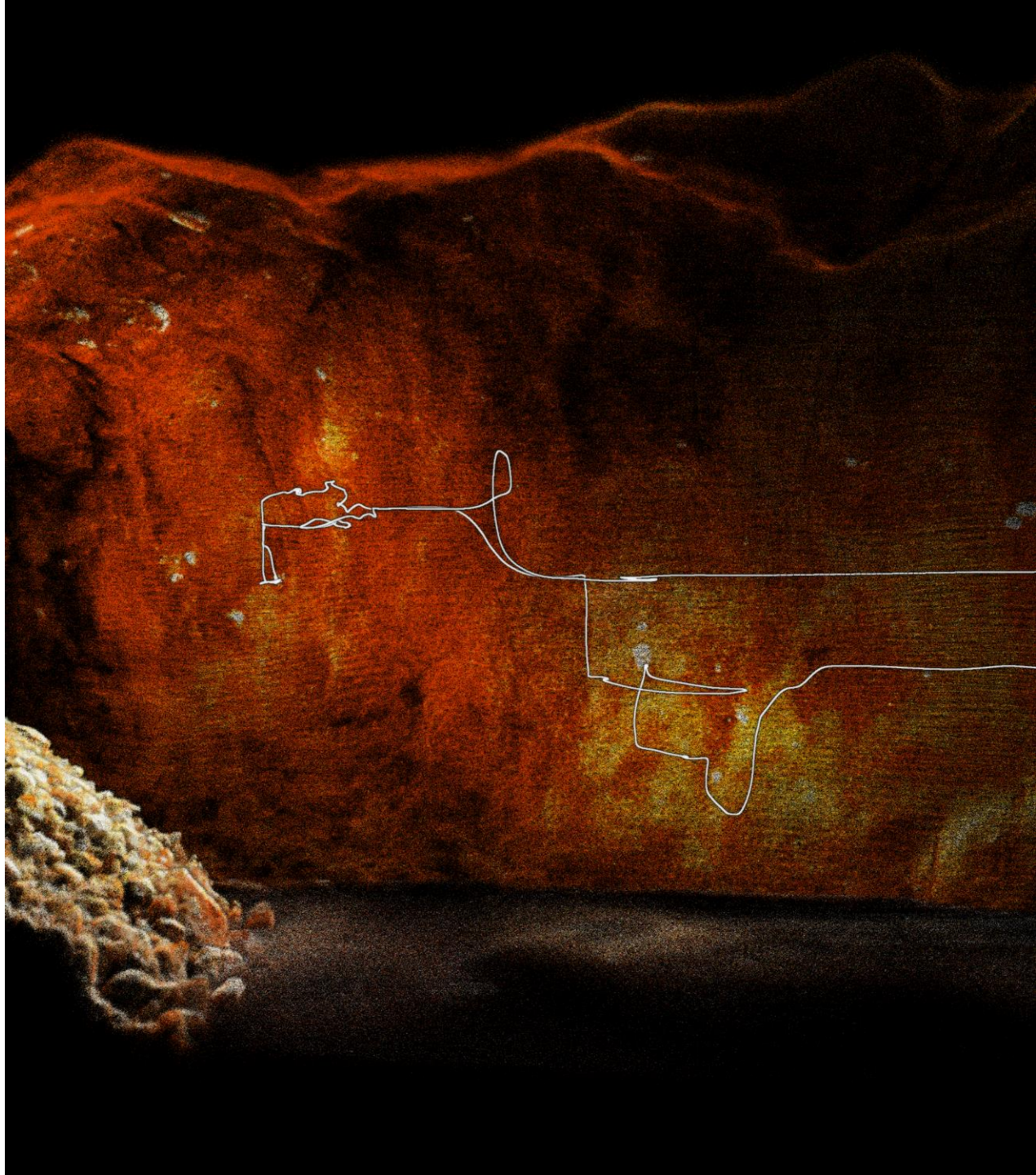
- Hydropower station
- Hyltebruk, Sweden

A sinkhole on the surface alerted operators to a rockfall within the water tunnel. A Hovermap flight was used to ascertain the location of the rockfall blockage and scan the extent of the damage.

- DJI M210 v1 drone flight
- Beyond line-of-sight and communication range

The blockage was located, and the georeferenced scan was provided to the power station to include it in their comprehensive plant model.

AMKVO



SOLID WASTE MANAGEMENT FACILITY STOCKPILE SCAN

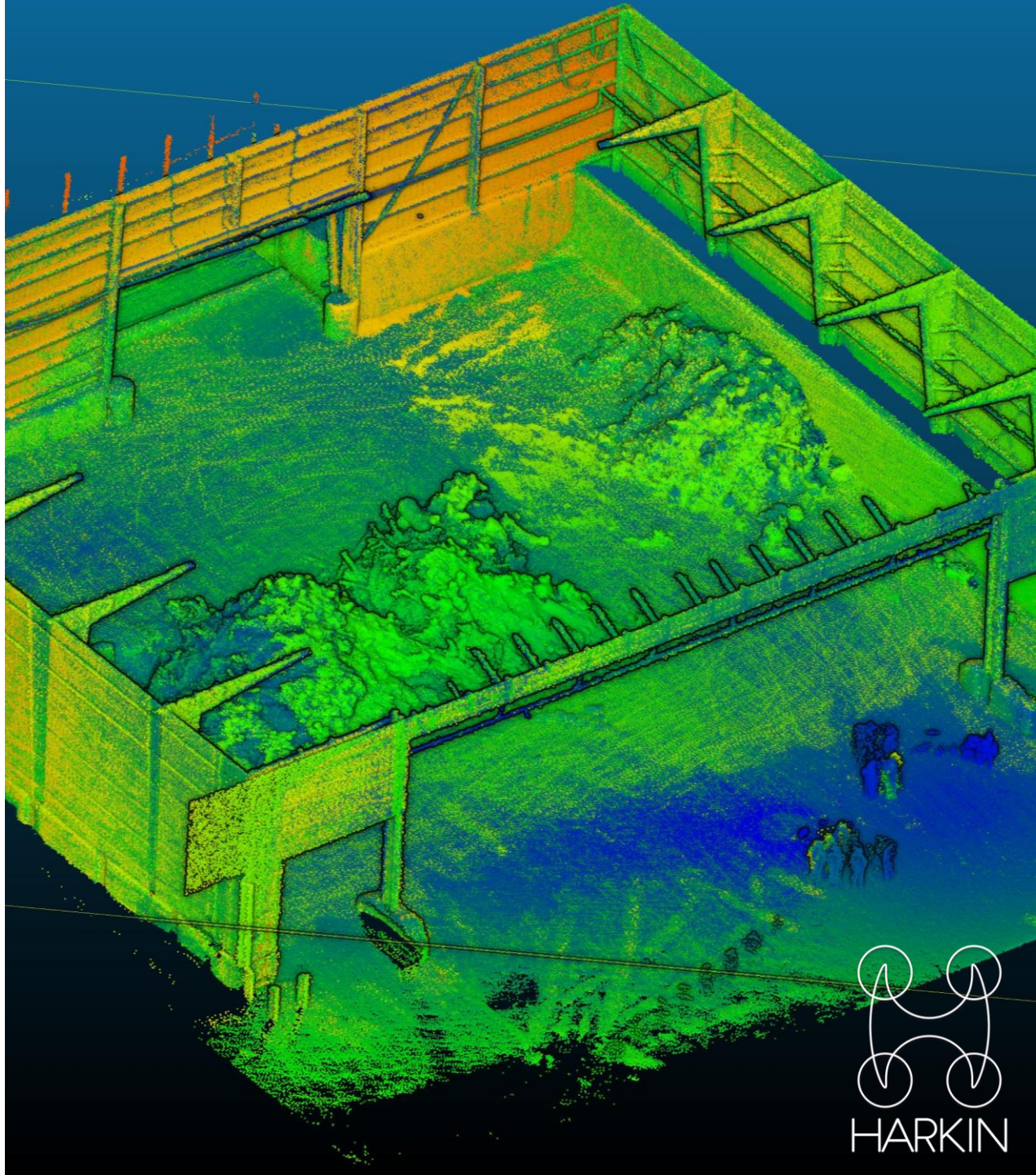
- New York City
- Piles of yard waste stored indoors
- 15-minute flying scan

Records, volumes, and measurements from structures are required to comply with New York State's Part 360 Solid Waste requirements.

The dataset was passed to an engineering firm that produced the outputs to comply with the regulations.

"To use a tripod for laser scanning would require a very tall tripod to scan the top of the piles and setting up and breaking down of the scanner over and over to capture the entire area."

Scott Harrigan, President, Harkin Aerial



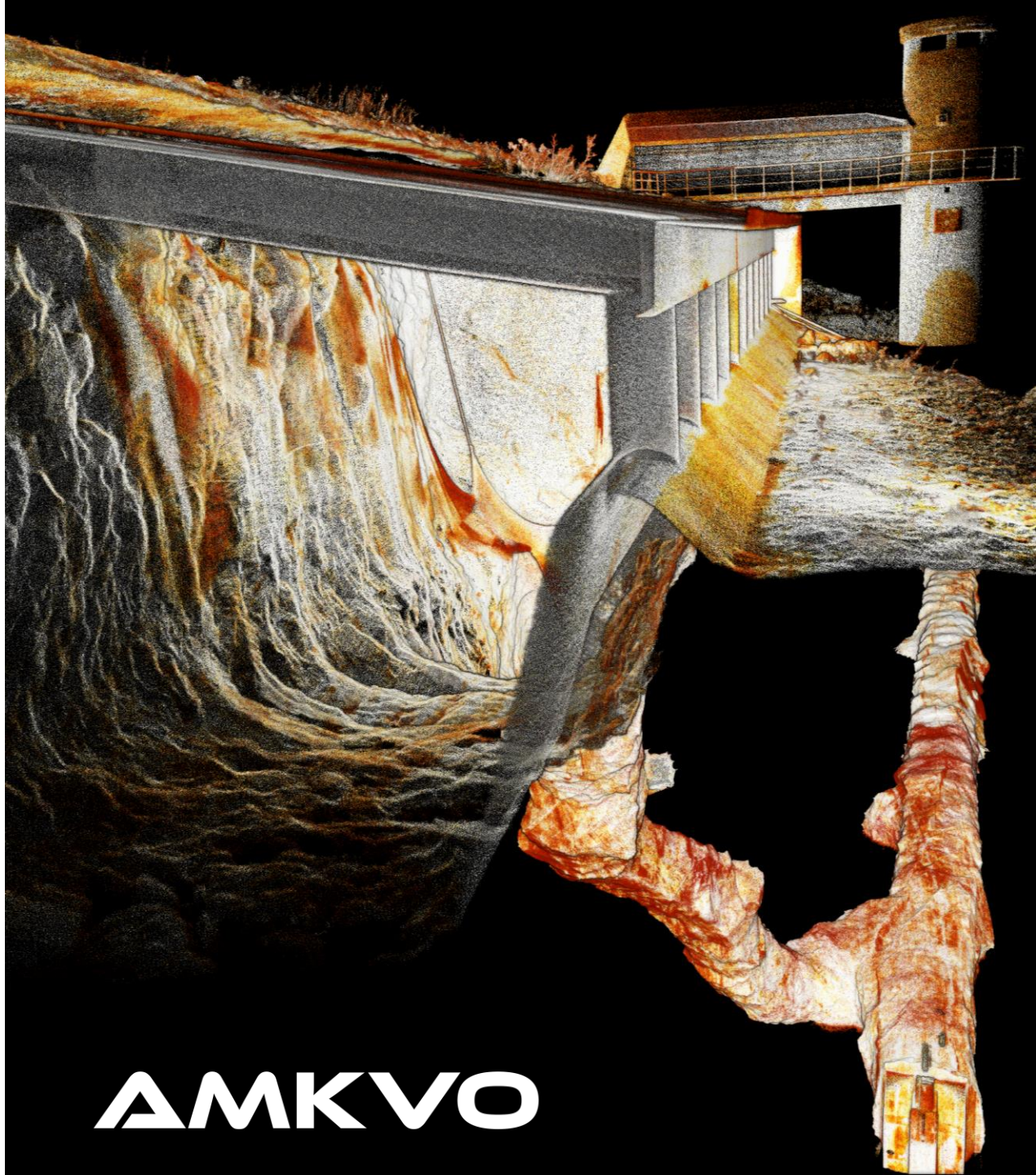
DAM OVERFLOW TUNNEL SCAN

- Hydropower station
- Central Norway
- Commenced operation in 1960 – 1963

The hydro station needed an understanding of the condition of the spillway tunnel attached to one of their feeder dams.

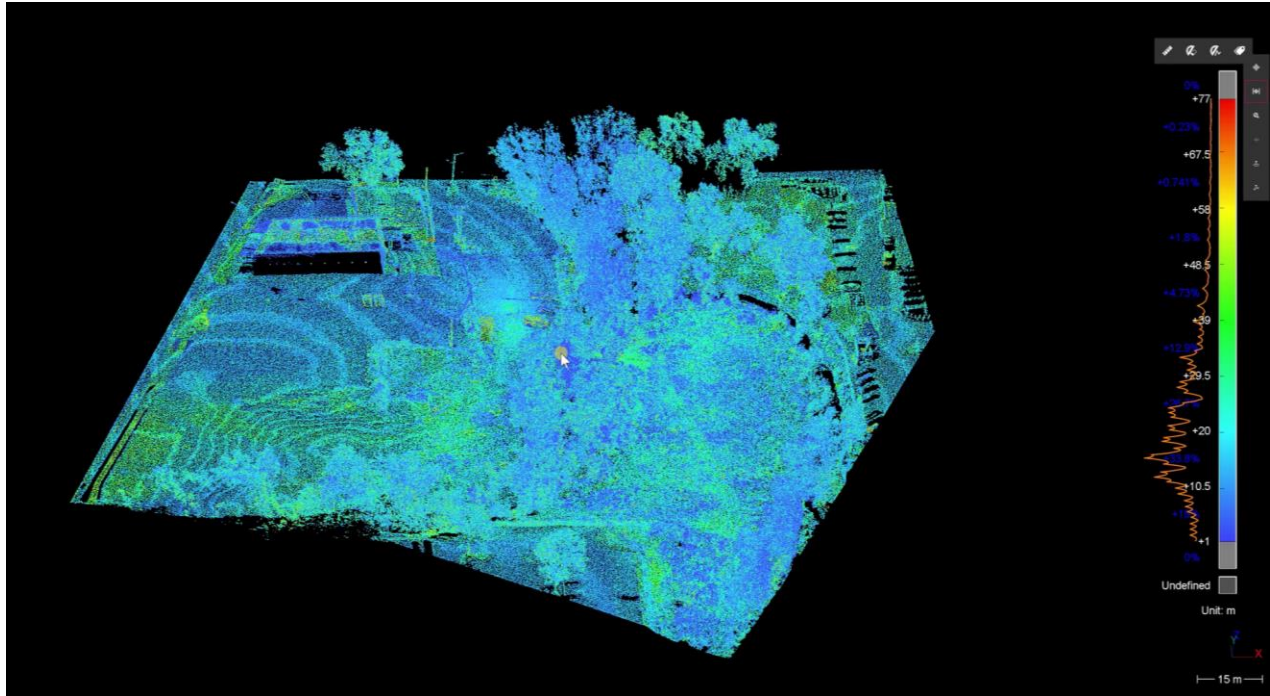
- Walking scan through the accessible tunnel
- Flying scan up a vertical tunnel and through the spillway

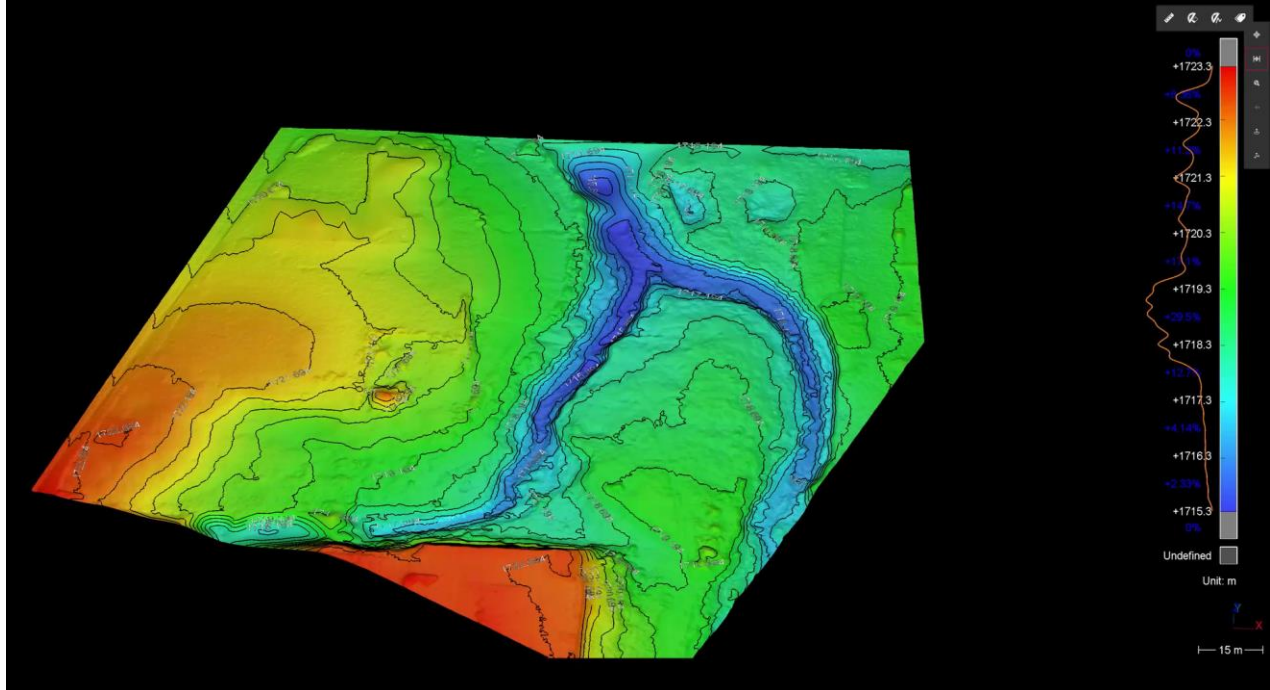
The dataset has been used to create an as-built model and review the condition of the tunnel and spillway, some of which hasn't been seen since it was constructed.



TERRAIN LAND DEVELOPMENT

- Construction and engineering company Kimley-Horn needed a terrain model for a civil engineering design
- Captured in a 15-minute flight
- Point cloud processed to remove vegetation and produce a contoured digital terrain model





CATHEDRAL HERITAGE SCAN

- San Bernardino de Siena cathedral
- Xochimilco, Mexico City
- 16th-century church and monastery
- Still used as a place of worship today

The scan was to capture the extent of earthquake damage to plan reconstruction and restoration.

- 11 walking scans
- no more than 15 minutes each

Collecting information of an architectural and topographic nature is of great importance to establish strategies for conserving world heritage.

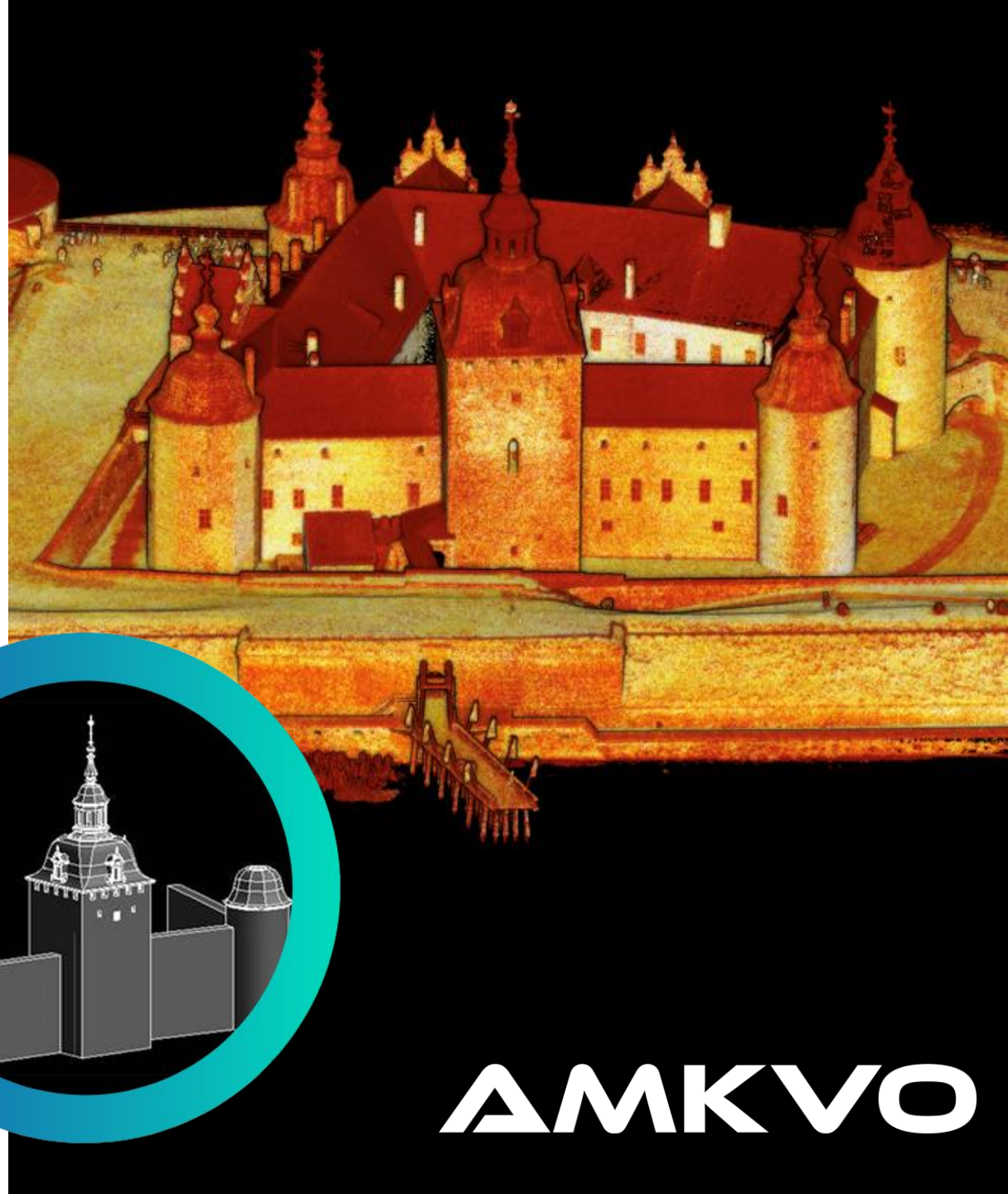
CASTLE AS-BUILT SCAN

- Kalmar Castle
- Kalmar, Sweden
- 12th –century fortress castle

Captured as a test to decide what scanner to use to obtain the digital twin of Kalmar as a city. Hovermap was chosen because of its speed and versatility.

- 5x 15-minute flying scans
- Capturing the entire castle took 4 hours, including processing time

The dataset will be used to produce a map, in volume calculations for earthworks, for linear and area measurements, to create digital terrain models and digital elevation models for urban planners.



INTERNAL OFFICE SCAN

- Captured in 15-minute walking scan
- Processed in 35 minutes

Scan modeled into Revit to provide basic floor plan and square meter calculations.

This information can be used for refitting the space, leasing calculations, complying with safety requirements, and much more.

“It was much quicker to capture this data with Hovermap.”

Alexander Paulusson, CEO, AMKVO

BULK OIL STORAGE TANK

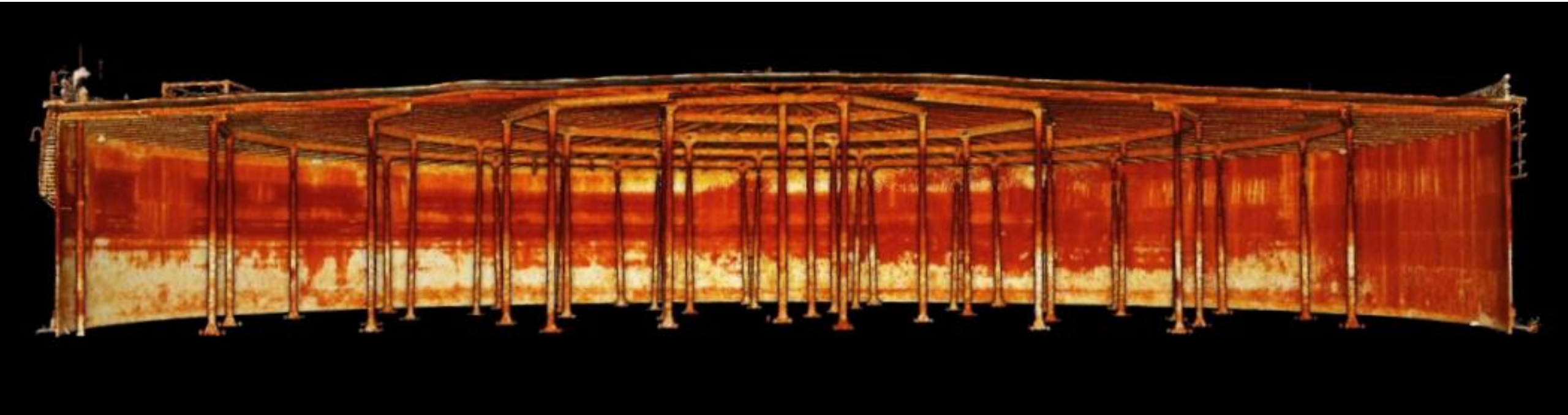
- Pertamina crude oil refinery
- Balongan, Indonesia
- 1,306,642 cubic foot (37,000m^3)

The purpose of the scan was to safely capture an as-built model of the bulk oil storage tank constructed in 1972.

- 10-minute interior walking scan
- 10-minute exterior walking scan
- 6-minute flying scan

The dataset was processed to extract and label as-builts of the roof, shell, and support structures to update the site's schematic data and inform Close Visual Inspection (CVI) flight planning.

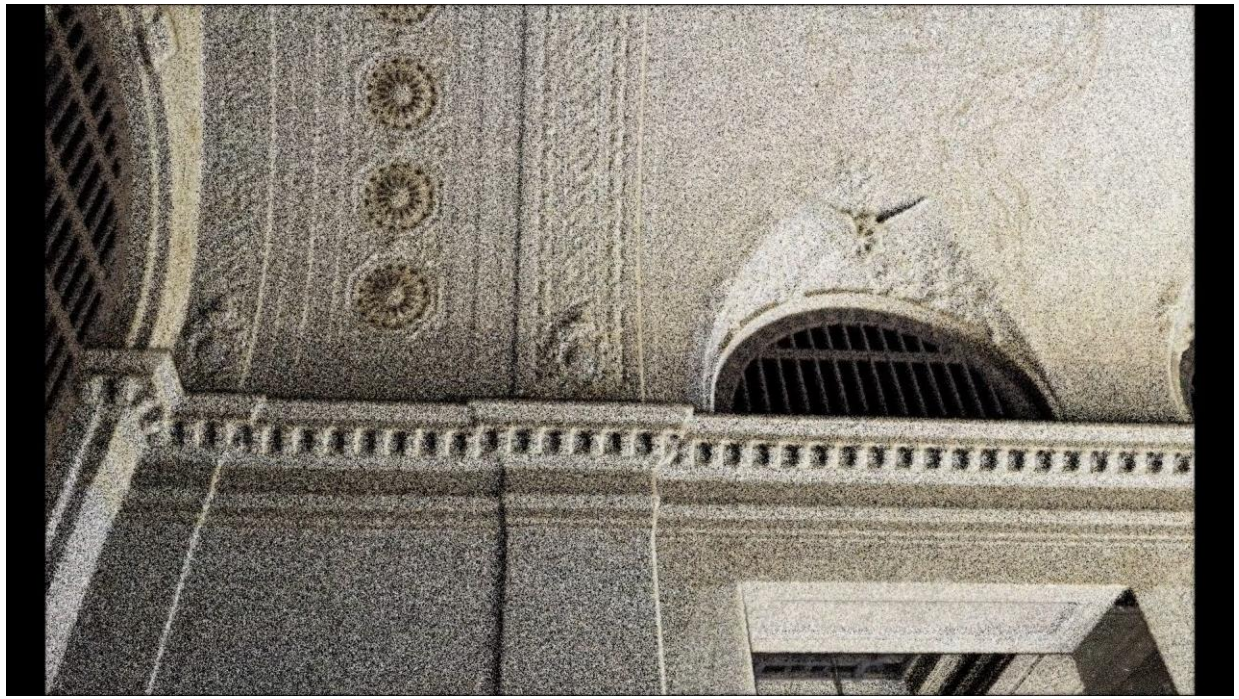
HALO ROBOTICS



TRANSIT TERMINAL SCAN

- Grand Central Station
- New York

The entire main hall, including a complete capture of the iconic ceiling, was captured from a walking scan on the main floor.



MASS RAPID TRANSIT PROJECT

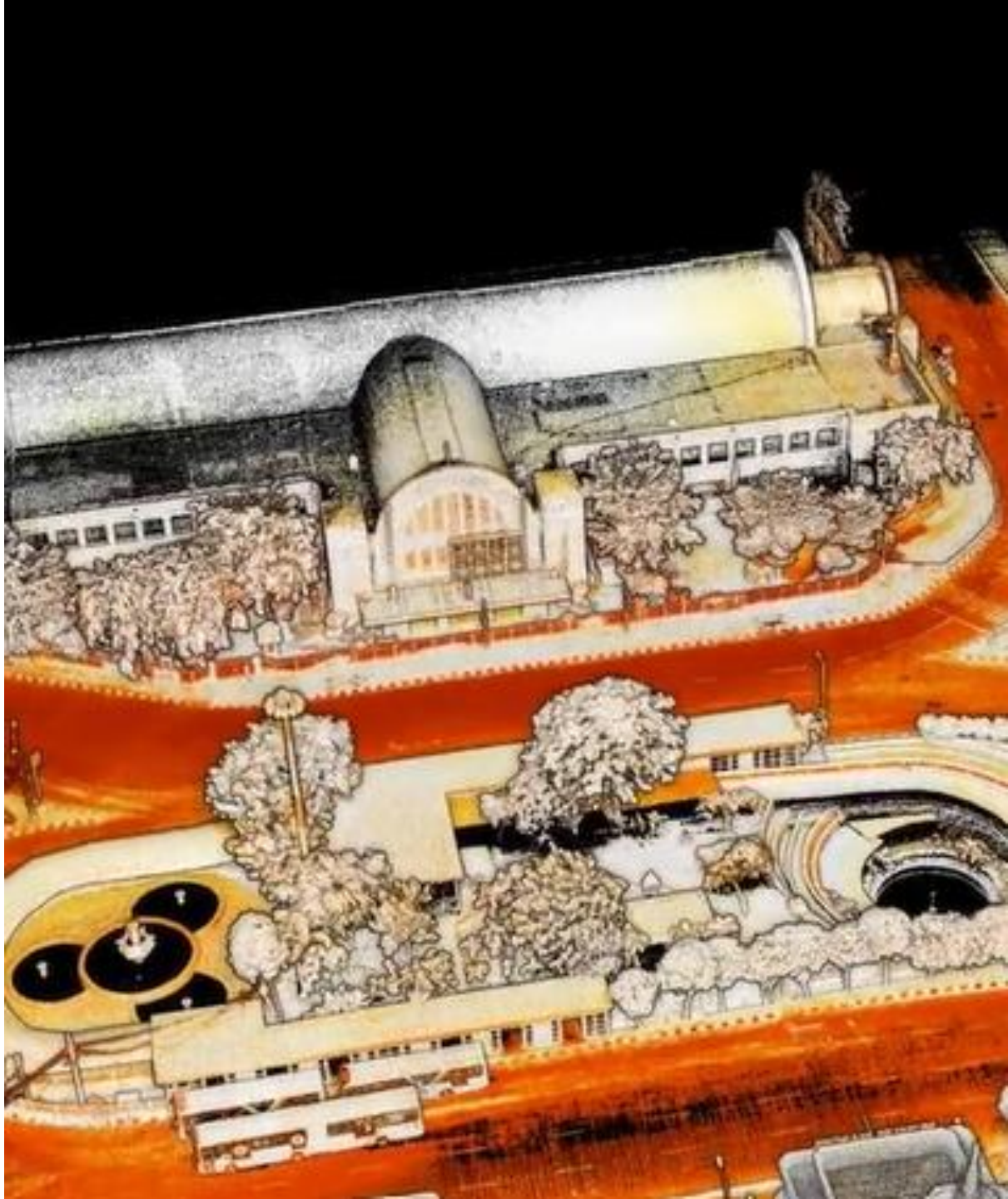
- Heritage area
- Jakarta, Indonesia

- 4-hours onsite, including setting ground control points

The point clouds delivered were of survey-level accuracy to an average dZ ~3/16 inch (~5mm).

The dataset was processed for as-builts and as a baseline survey for change detection during construction.

HALO ROBOTICS



MUSEUM SPACE MANAGEMENT

- USS Midway Museum
- San Diego, California
- 1930s TBD Devastator aircraft

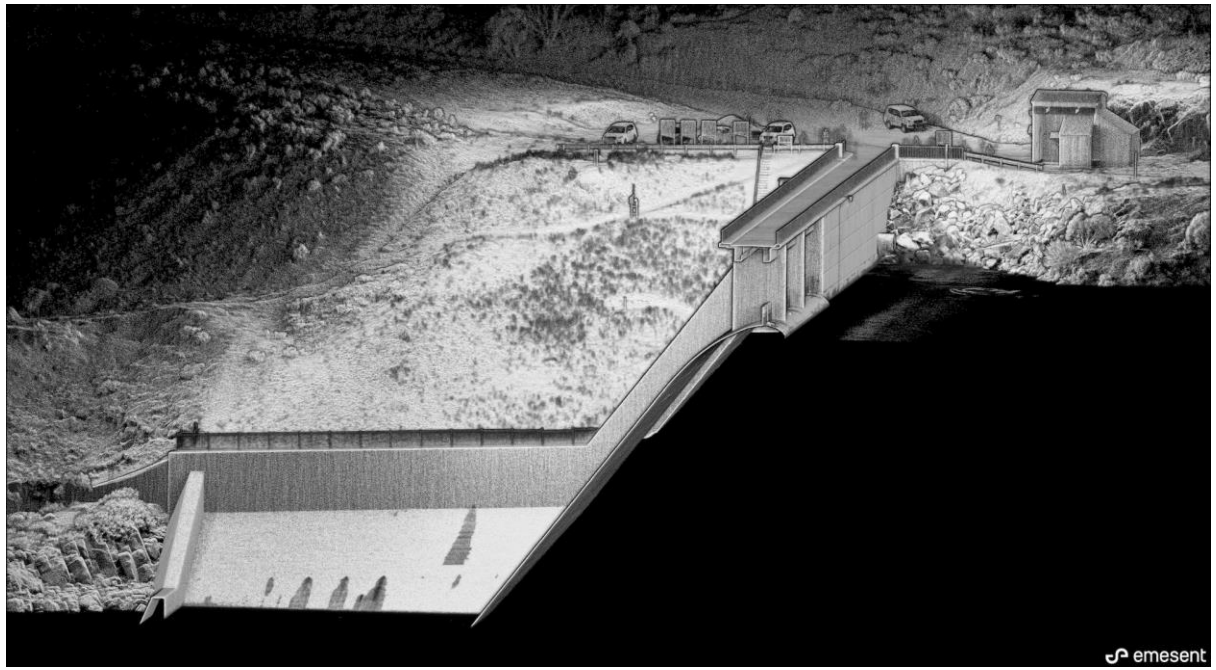
The scan was to confirm whether the aircraft that was stored with wingtips detached could be accommodated reassembled in the proposed new space.

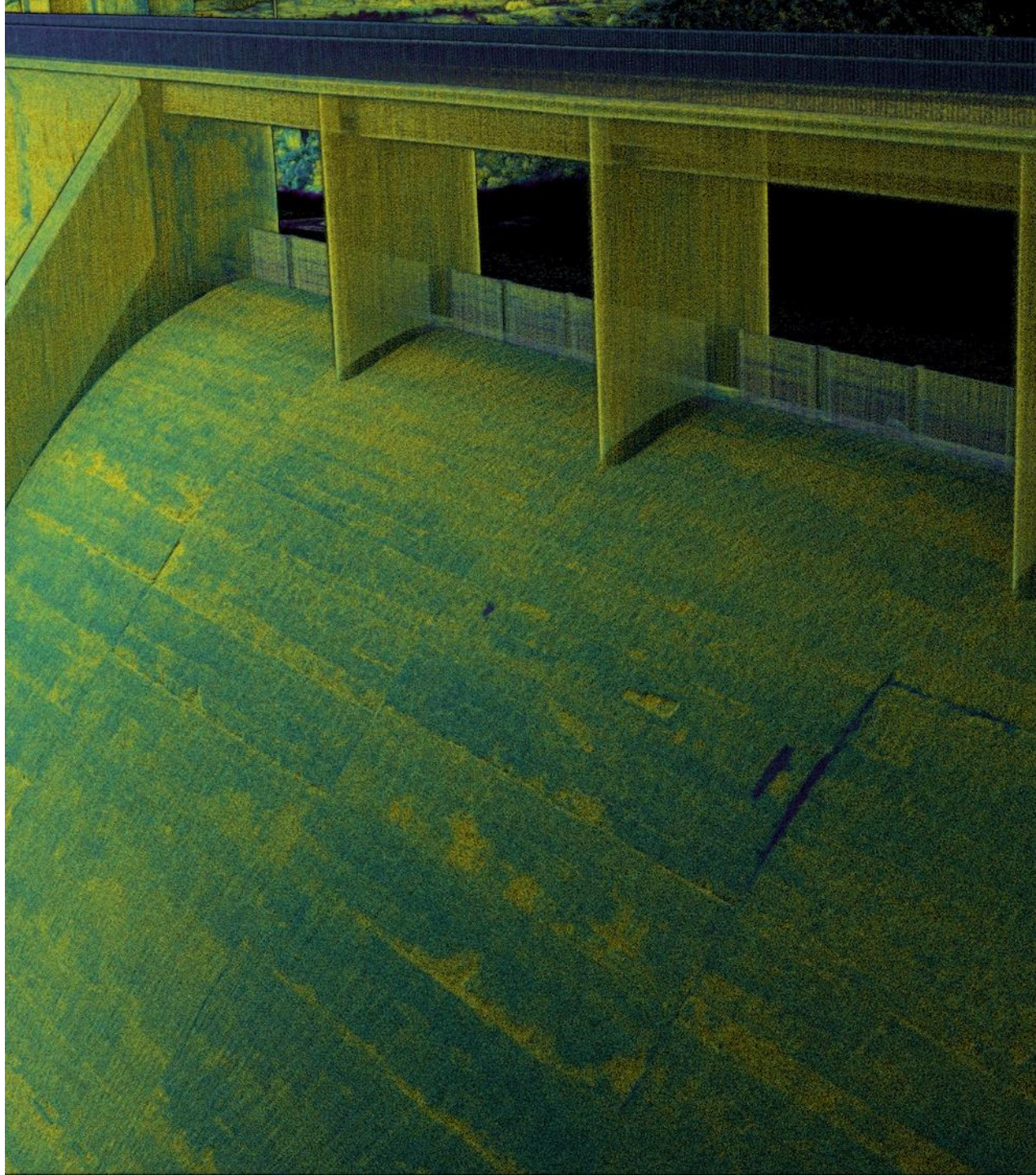
- 20-minute scan of the plane, proposed exhibit space, and path to new space.

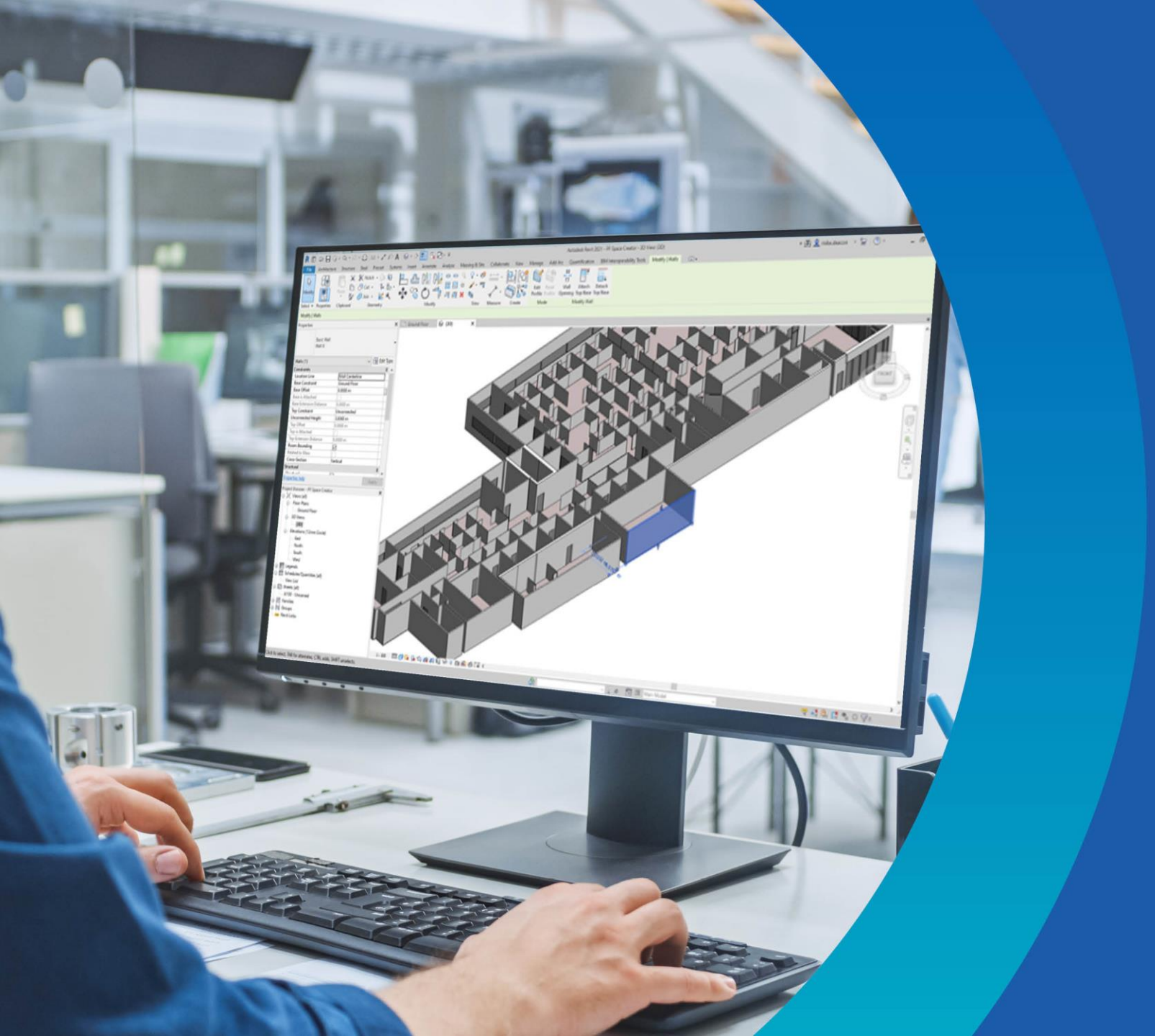
After processing the scan, the wingtips were virtually replaced, and the completed plane was moved virtually to its new location to confirm it would fit.

DAM CONDITION INSPECTION

- 15-minute flight to capture dam wall and geotechnical data of spillway
- Multi-attribute data enables different visualizations. Intensity highlights area of water seepage





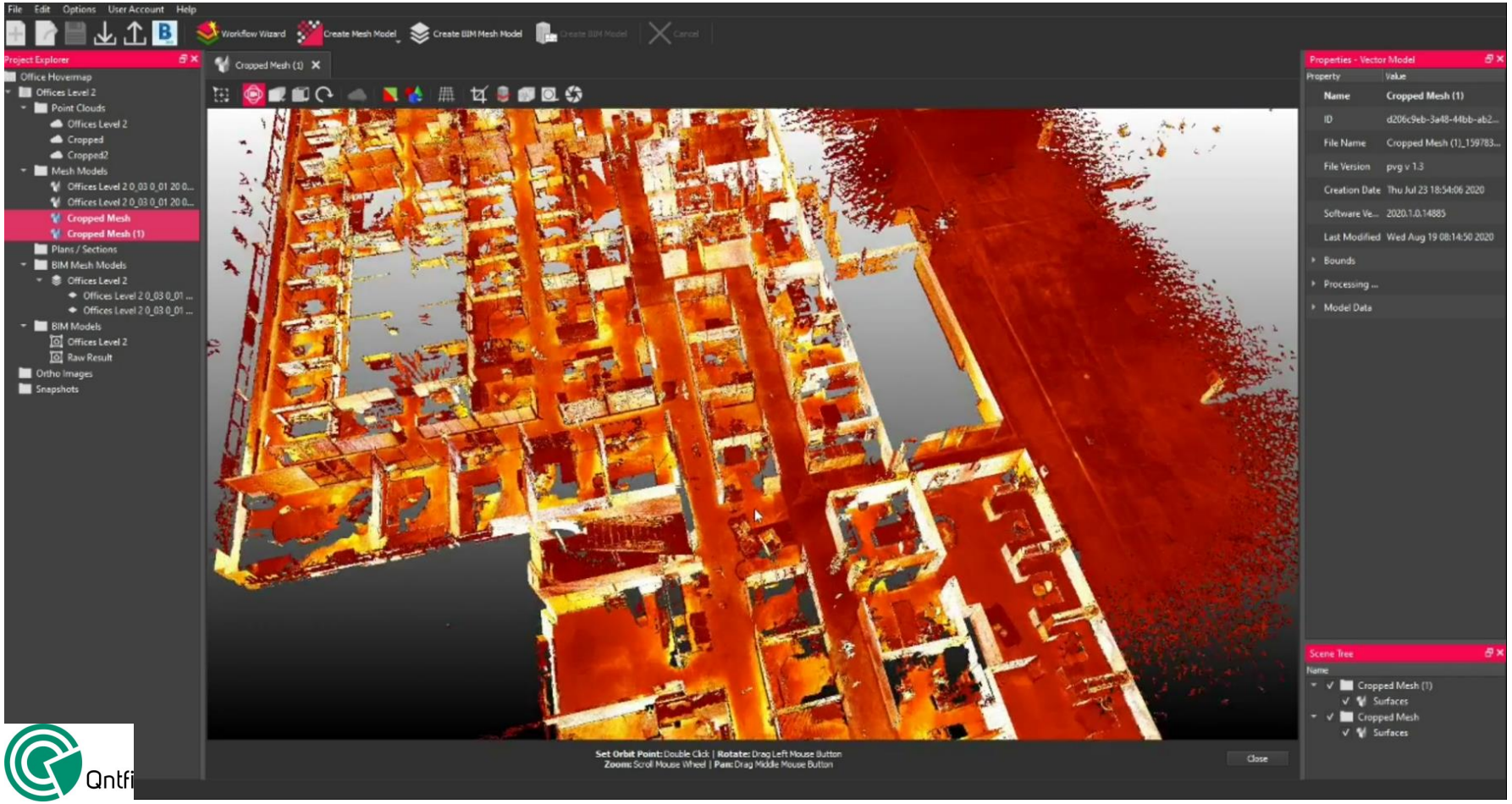


WORKFLOWS

POINT CLOUD TO BIM WORKFLOWS IN POINTFUSE

POINT CLOUD TO BIM WORKFLOW IN POINTFUSE

- Hovermap low-noise point cloud → Pointfuse → segmented mesh



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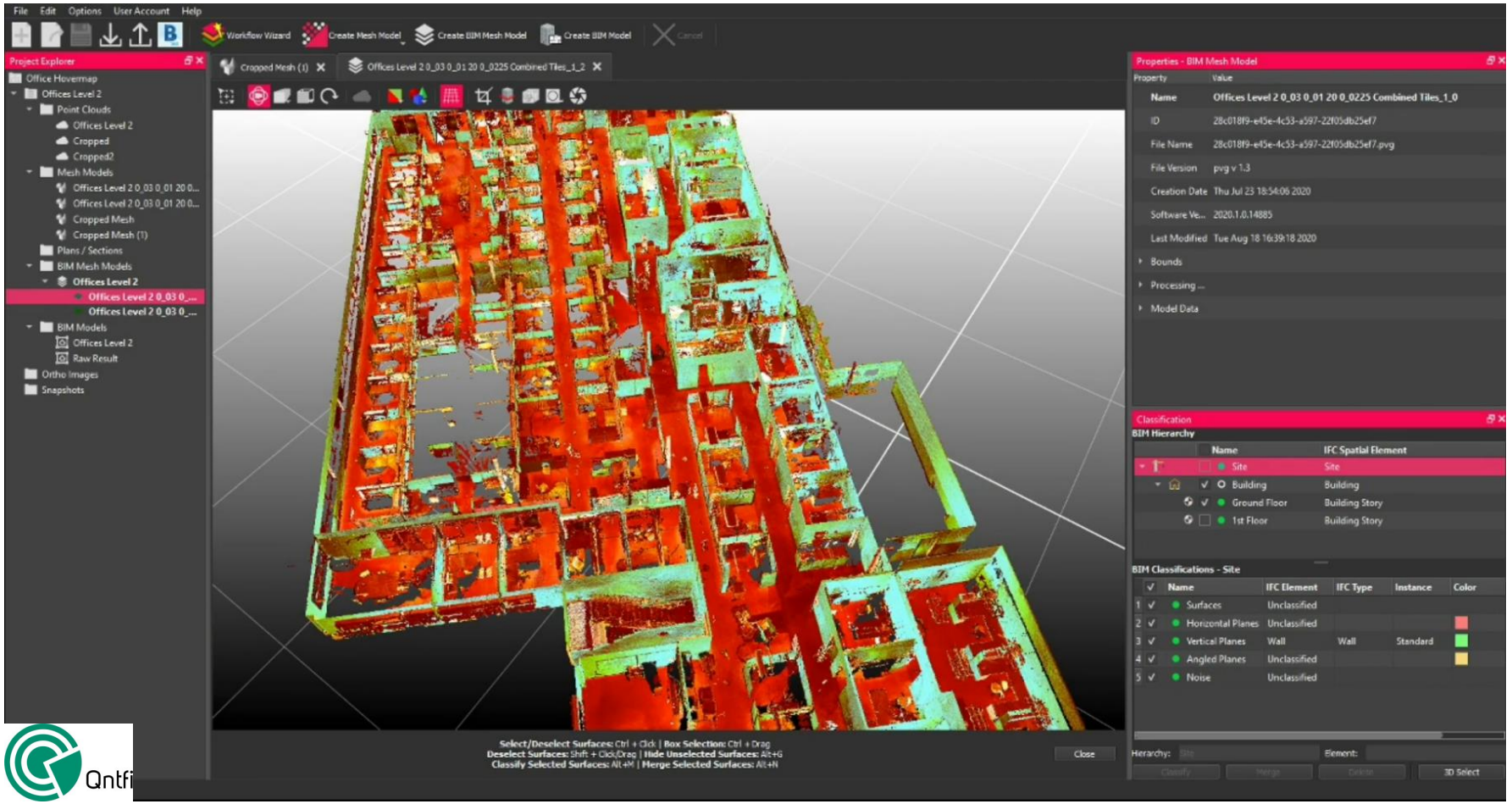
POINT CLOUD TO BIM WORKFLOW IN POINTFUSE

- Hovermap low-noise point cloud → Pointfuse → BIM mesh



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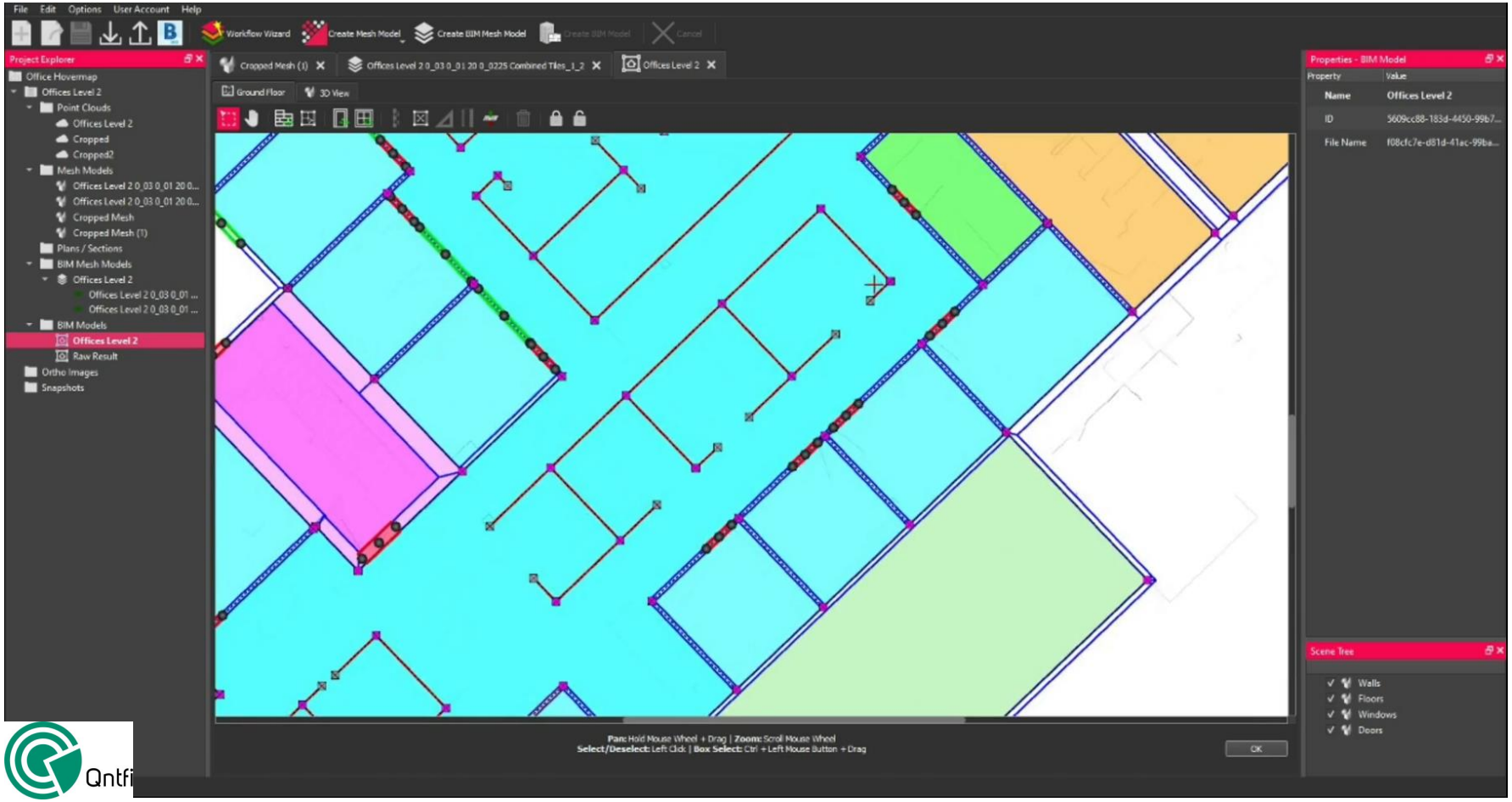
POINT CLOUD TO BIM WORKFLOW IN POINTFUSE

- Hovermap low-noise point cloud → Pointfuse → Parametric BIM



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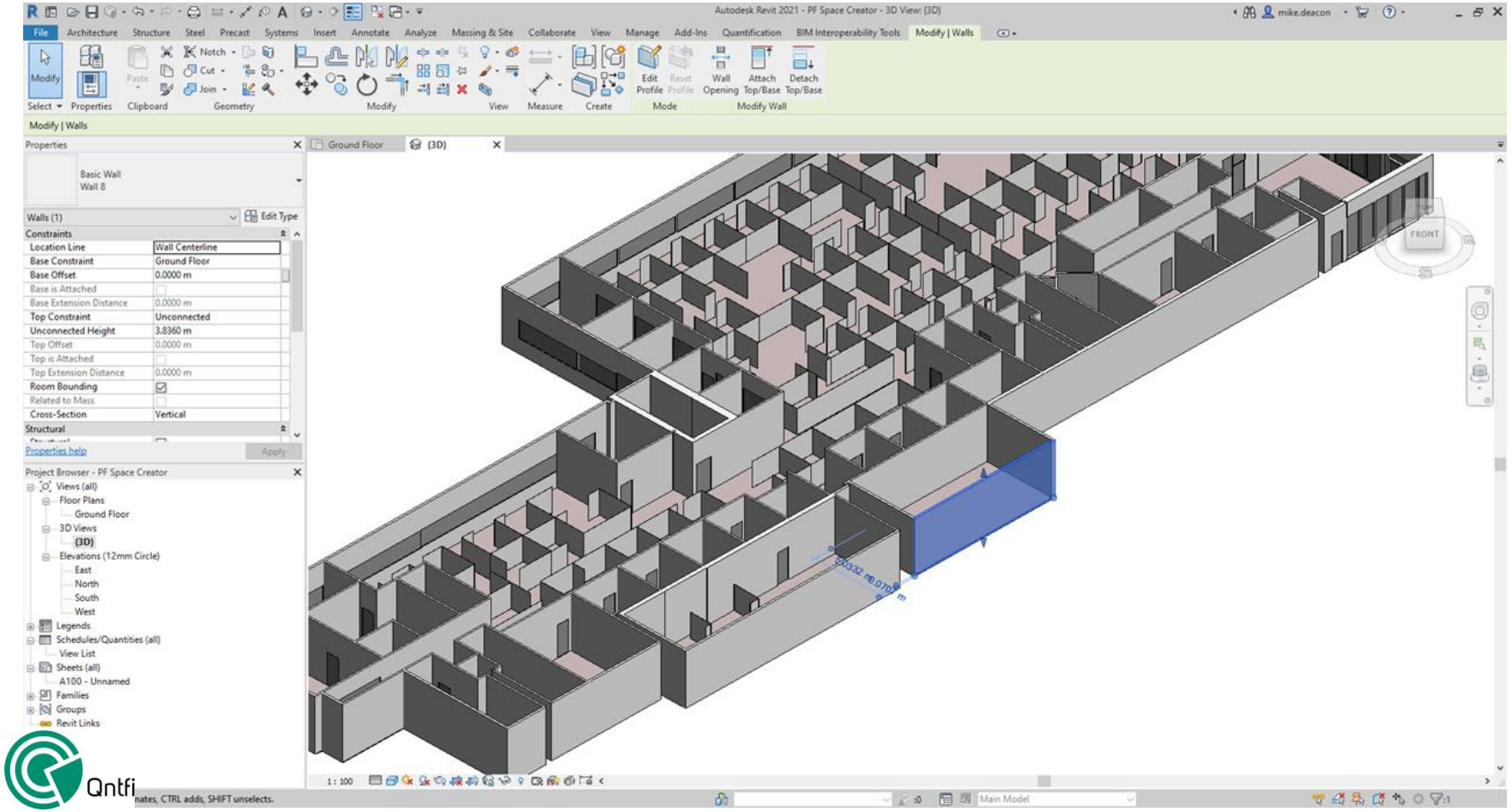
POINT CLOUD TO BIM WORKFLOW IN POINTFUSE

- Hovermap low-noise point cloud → Pointfuse → Revit BIM



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CAD-READY DATA

AEC DELIVERABLES

AS-BUILT: THE CENTER FOR THE ARTS, NEVADA COUNTY, CA

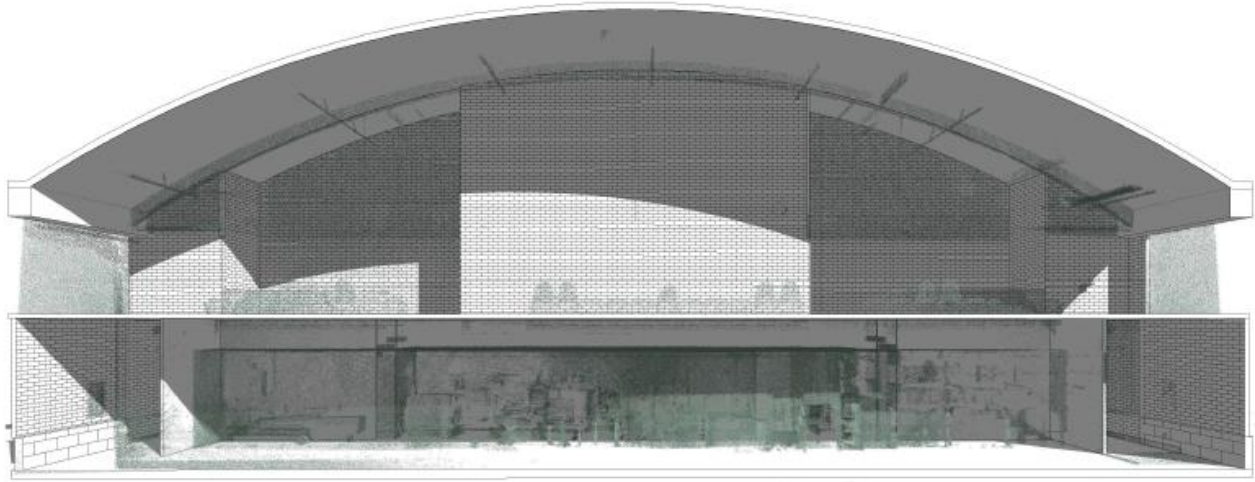
OPTIMIZES OPERATIONS PRE- AND POST-RENOVATION

- Multi-use 21,000 square foot facility, 492-seat Main Theater, visual arts galleries, classroom space, and a 90-seat black box theater
- Need: Up-to-date as-built of recent renovations and complete site to help reconfigure its spaces and enable on-line booking facilities
- Hovermap: 15-minute drone flight and 1-hour internal walking scan
- Deliverables: colorized external scan and internal scan merged to produce a complete CAD-ready point cloud
- Benefits: Improved logistics and space utilization

EROCK Associates LLC

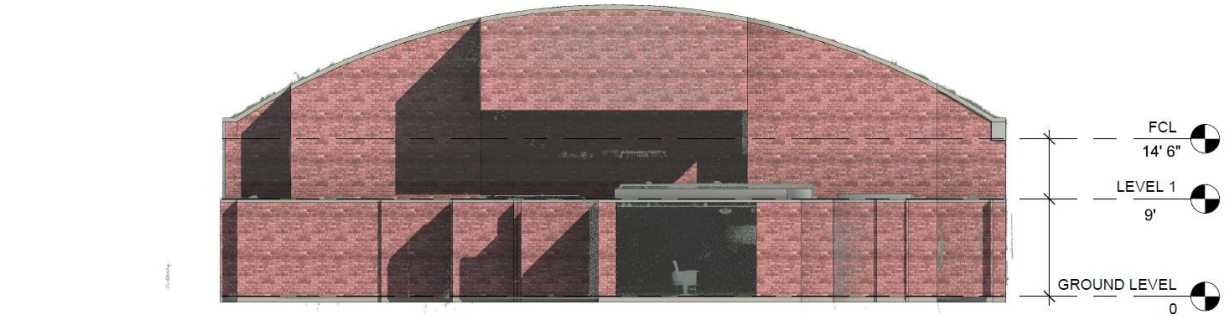
AS-BUILT: THE CENTER FOR THE ARTS, NEVADA COUNTY, CA

- CAD-Ready deliverables
  - Point cloud → ReCap → Revit

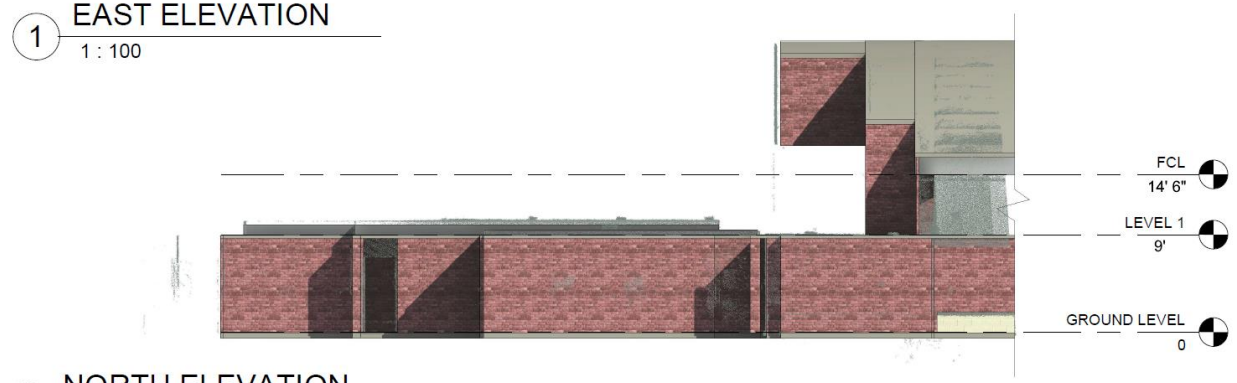


"We will see more immediate benefit from the work EROCK did, and the results of the Hovermap scans; we now have the ability to share floorplan, dimensions, etc. to help our clients plan their events remotely."

David Spellman, Director of Facilities and Operations,
Grass Valley Center for the Arts



1 EAST ELEVATION
1 : 100

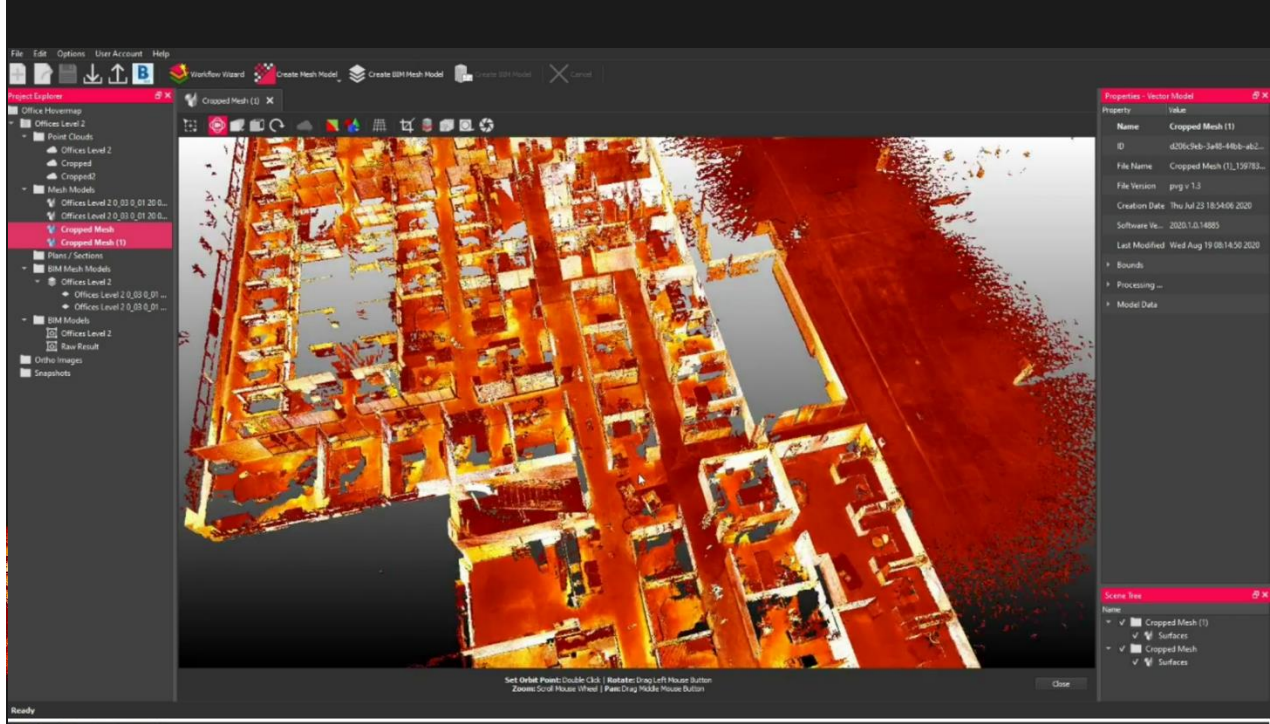


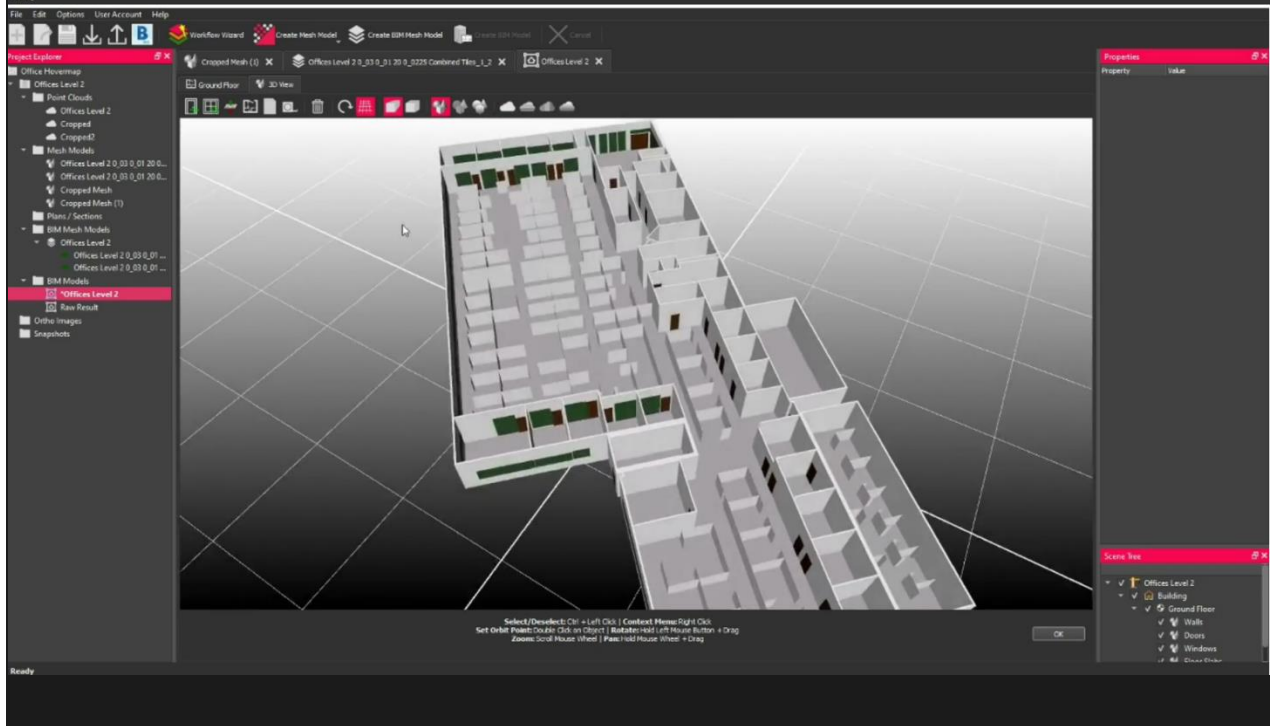
2 NORTH ELEVATION
1 : 100

EROCK Associates LLC

AS-BUILT: OFFICE BIM

- Renovation of factory office
- Need: As-built scan for factory offices and cube farm
- Hovermap: 15 min exterior and 15 min interior walking scans
- Deliverables: Point cloud and Pointfuse CAD-ready model
- Benefits: Rapid, low-cost model for client

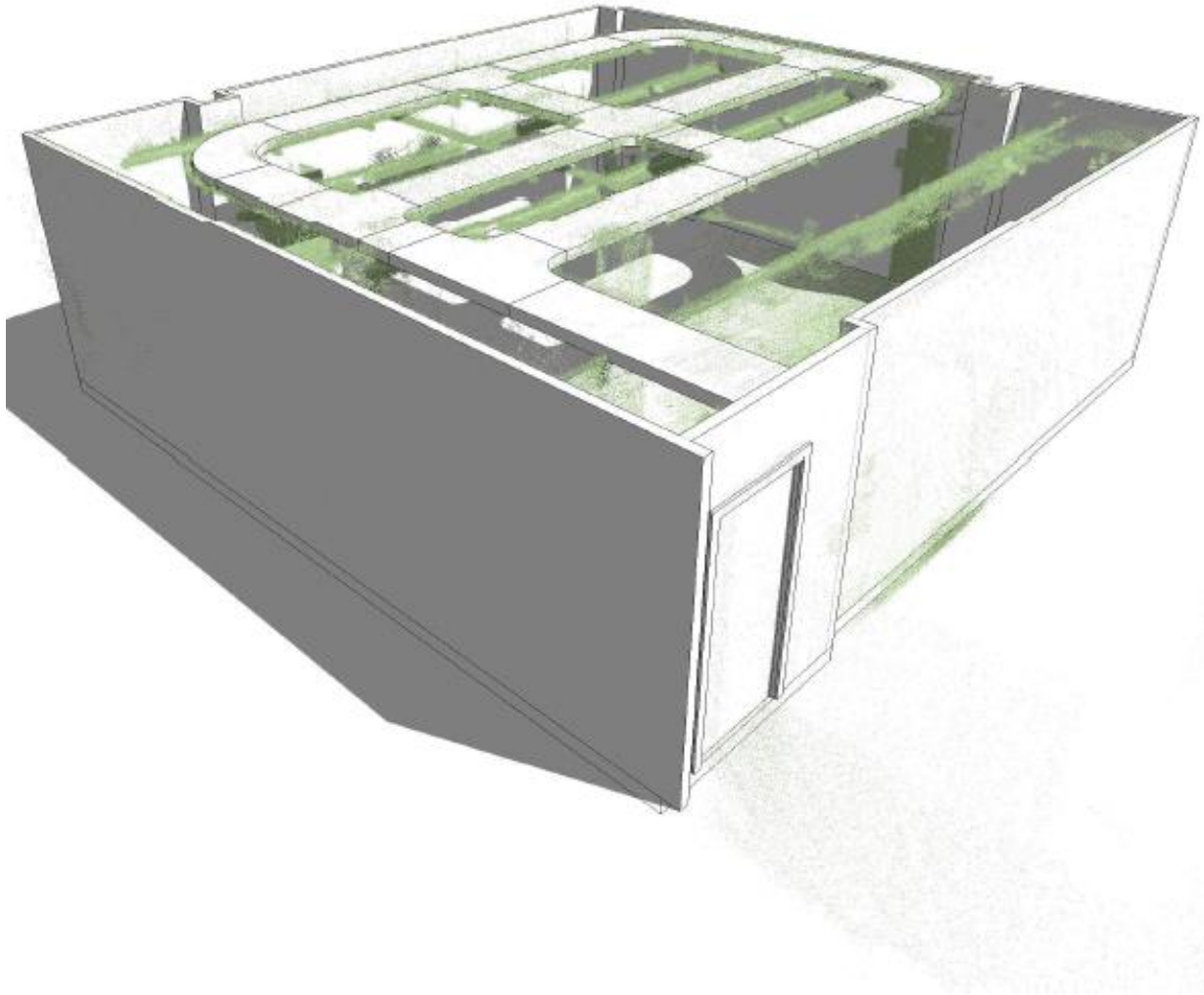




Qntfi

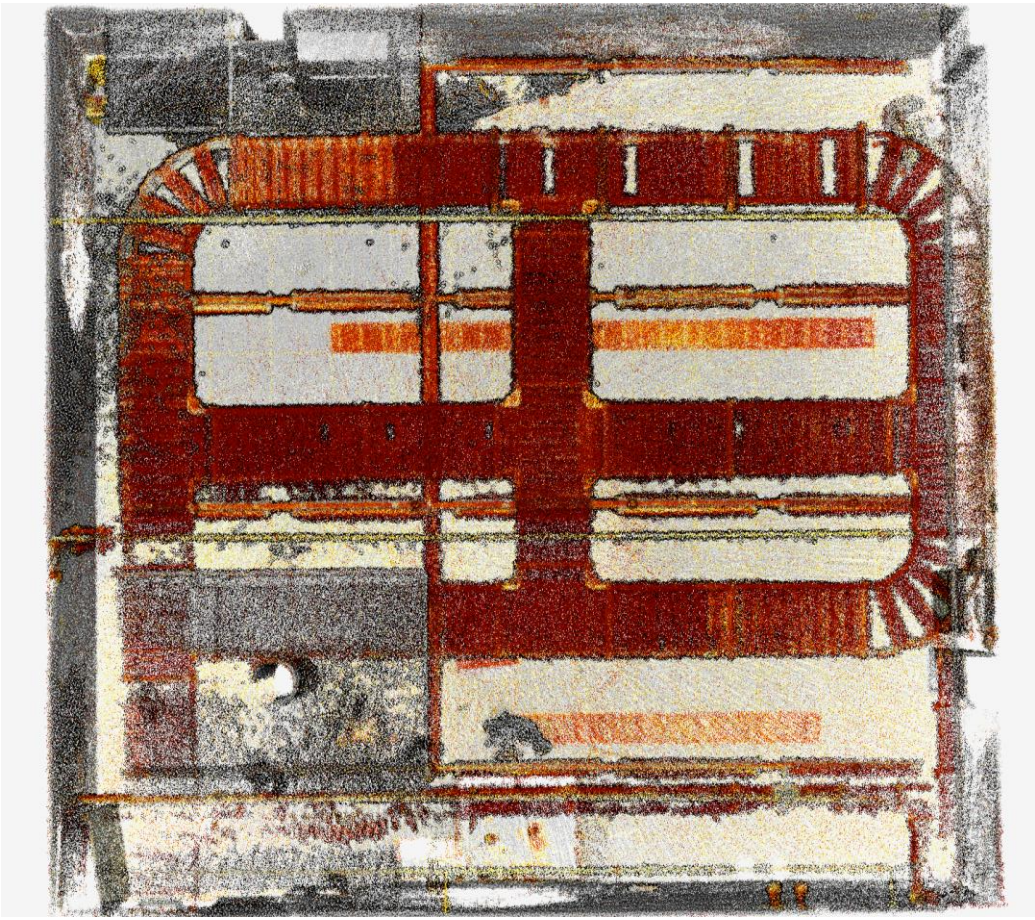
AS-BUILT: SERVER ROOM

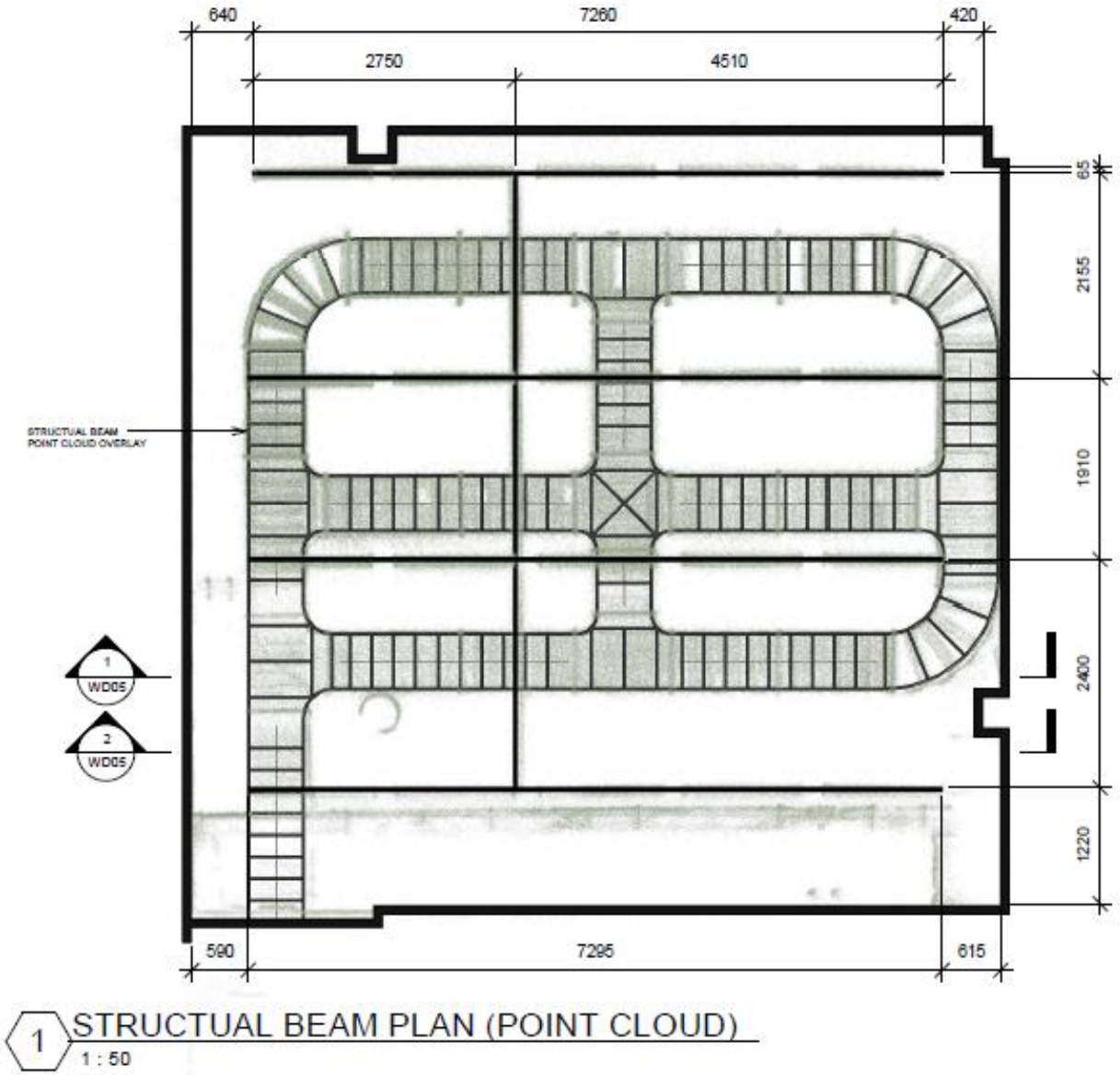
- Server Room Expansion
- Need: accurate plans of installed cable tray and room dimensions
- Hovermap: 2 min walking scan
- Deliverables: Revit working drawings produced from uncleaned pointcloud
- Benefits: Rapid capture and deliverables



DELIVERABLES: SERVER ROOM

- Uncleaned point cloud → ReCap → Revit

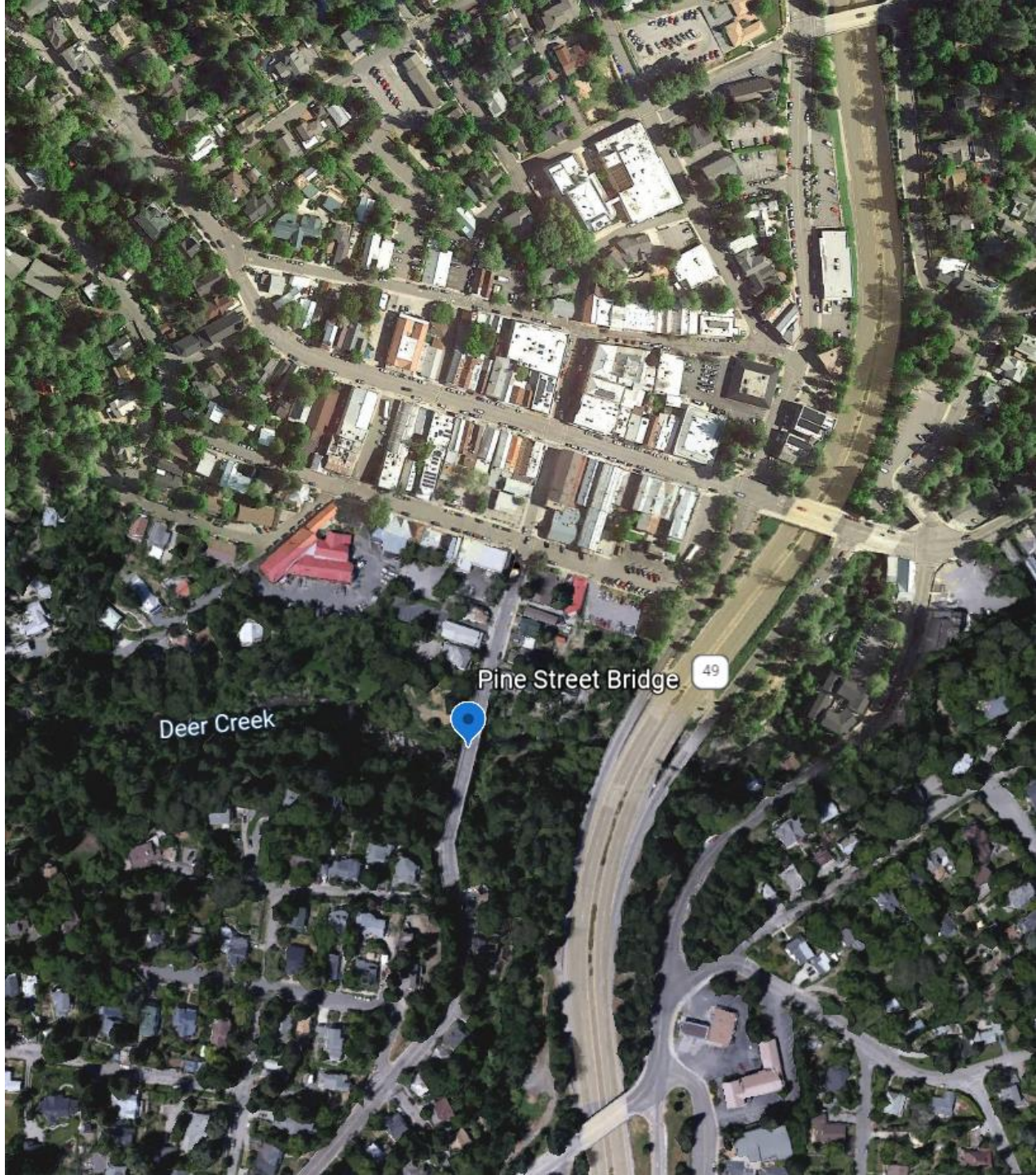




1 STRUCTUAL BEAM PLAN (POINT CLOUD)
1 : 50

BRIDGE INSPECTION

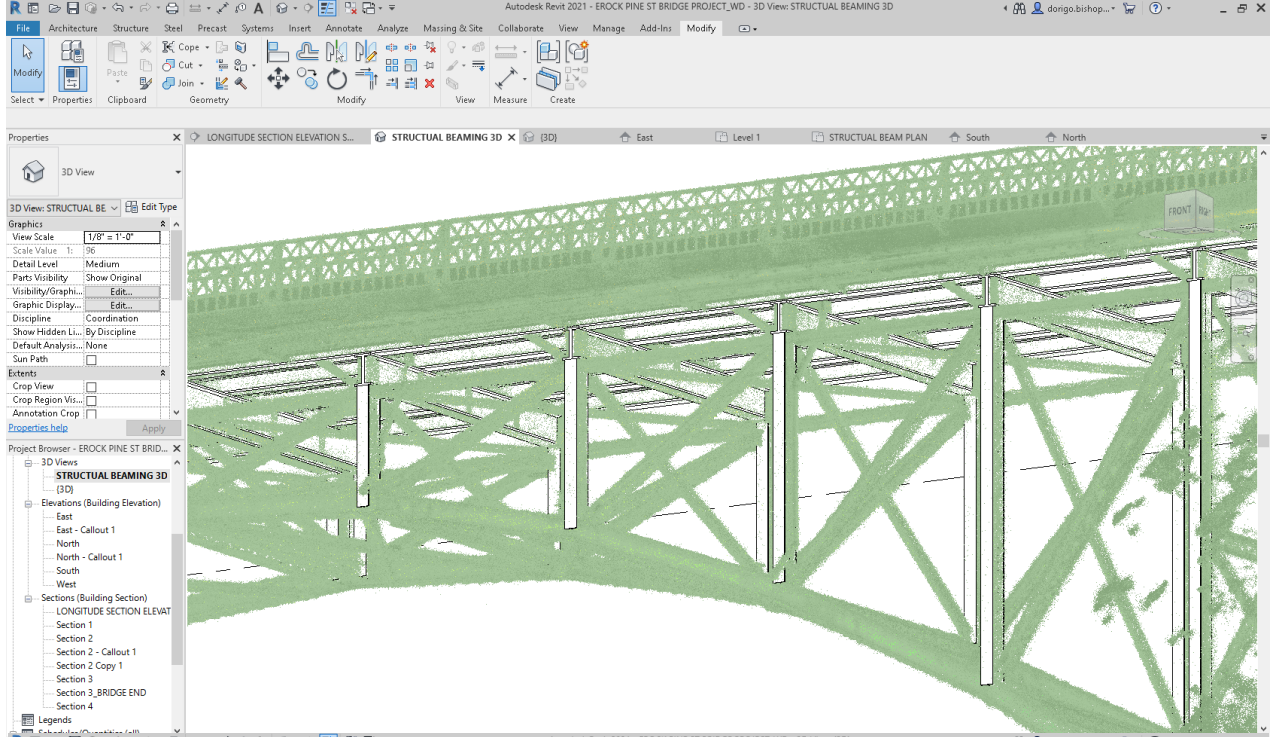
- Pine Street Bridge, Nevada City, CA
- Inspection for California Dept of Transportation (Caltrans) and Pacific Gas & Electric (PG&E)
- Need: Inspection of bridge and utilities passing underneath
- Hovermap: 15-min flight
- Deliverables: accurate, low-noise point cloud products that can drop into CAD

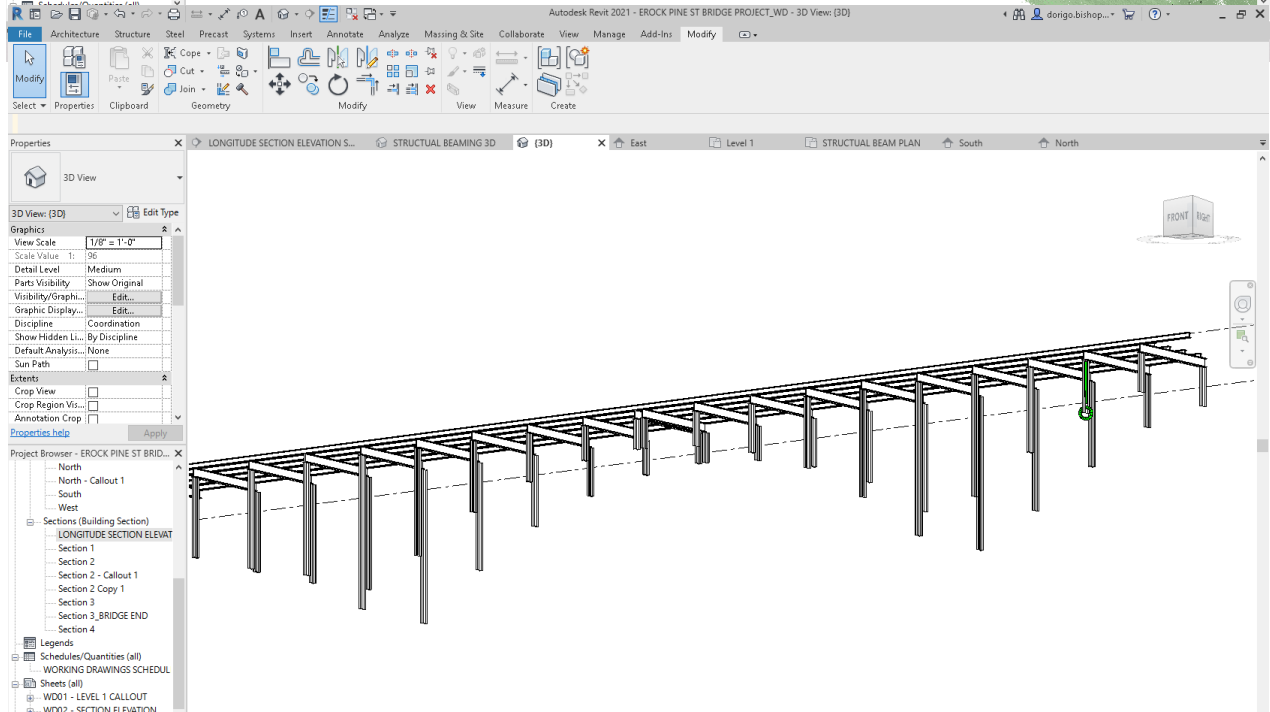


BRIDGE INSPECTION

Deliverables

- Point clouds
- Revit structural drawings

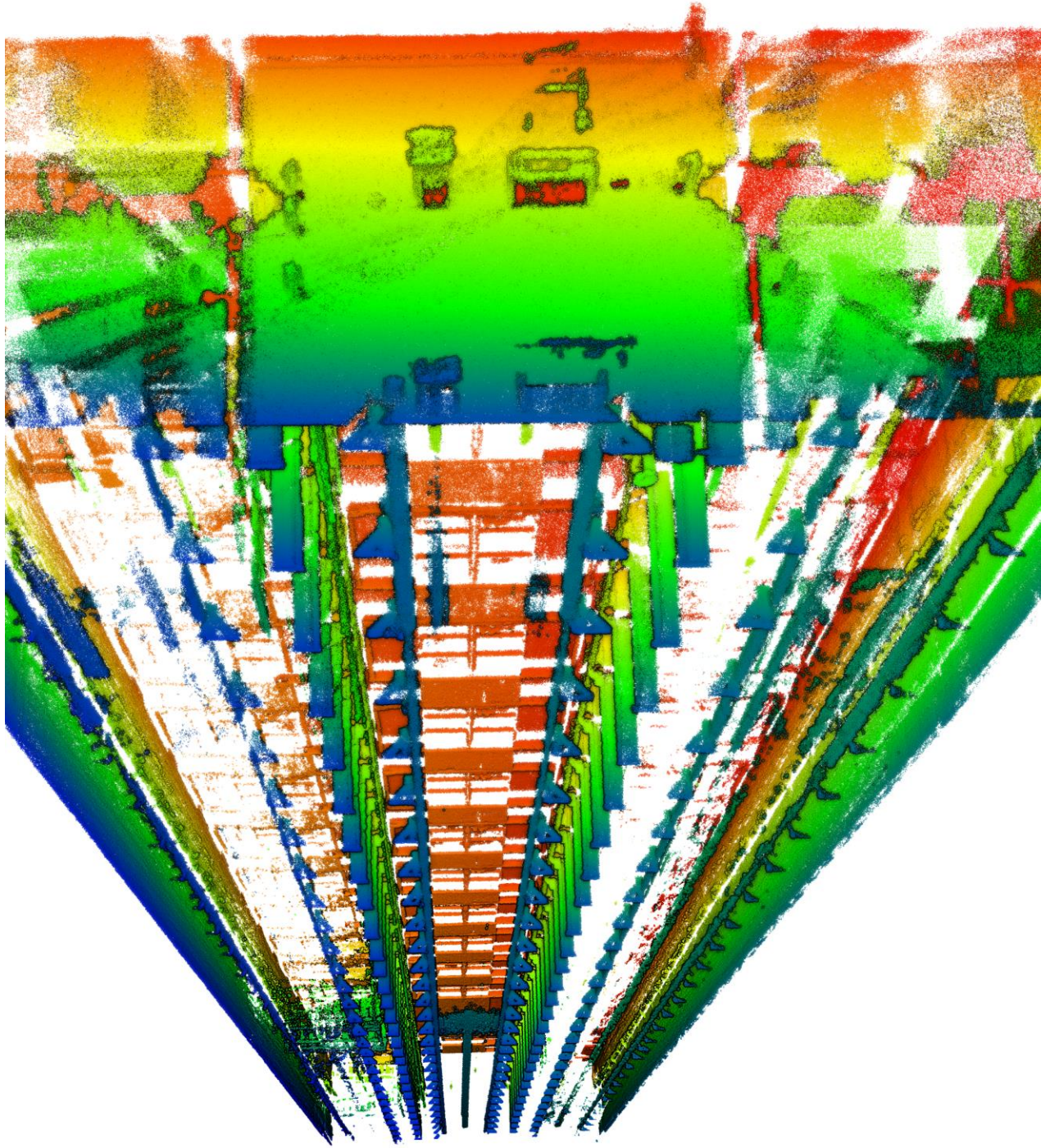




EROCK Associates LLC

AS-BUILT: ELEVATOR SHAFT

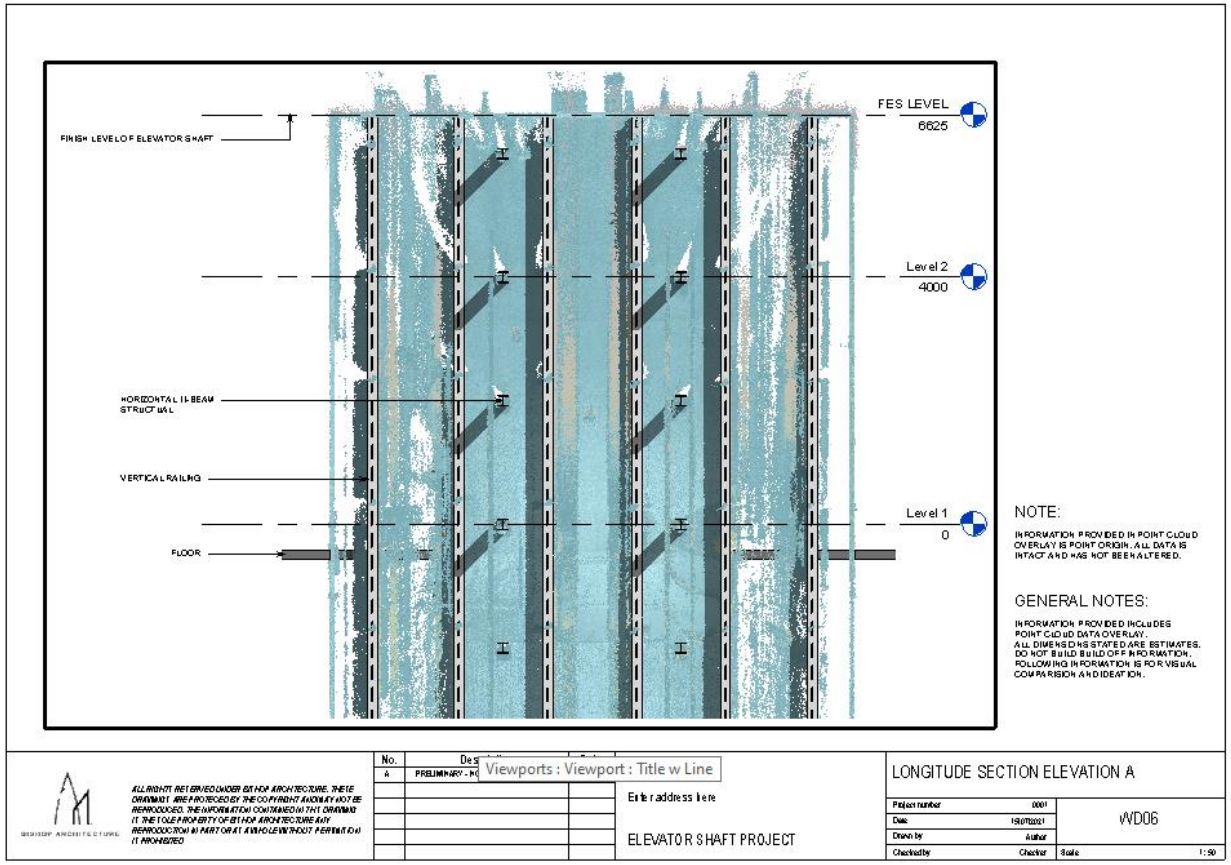
- Multi story elevator shaft scan
- Need: accurate as-built and structural plans and dimensions
- Hovermap: attached to roof of elevator with magnetic mount
- Deliverables: Revit working drawings produced from point cloud
- Benefits: Rapid capture and deliverables

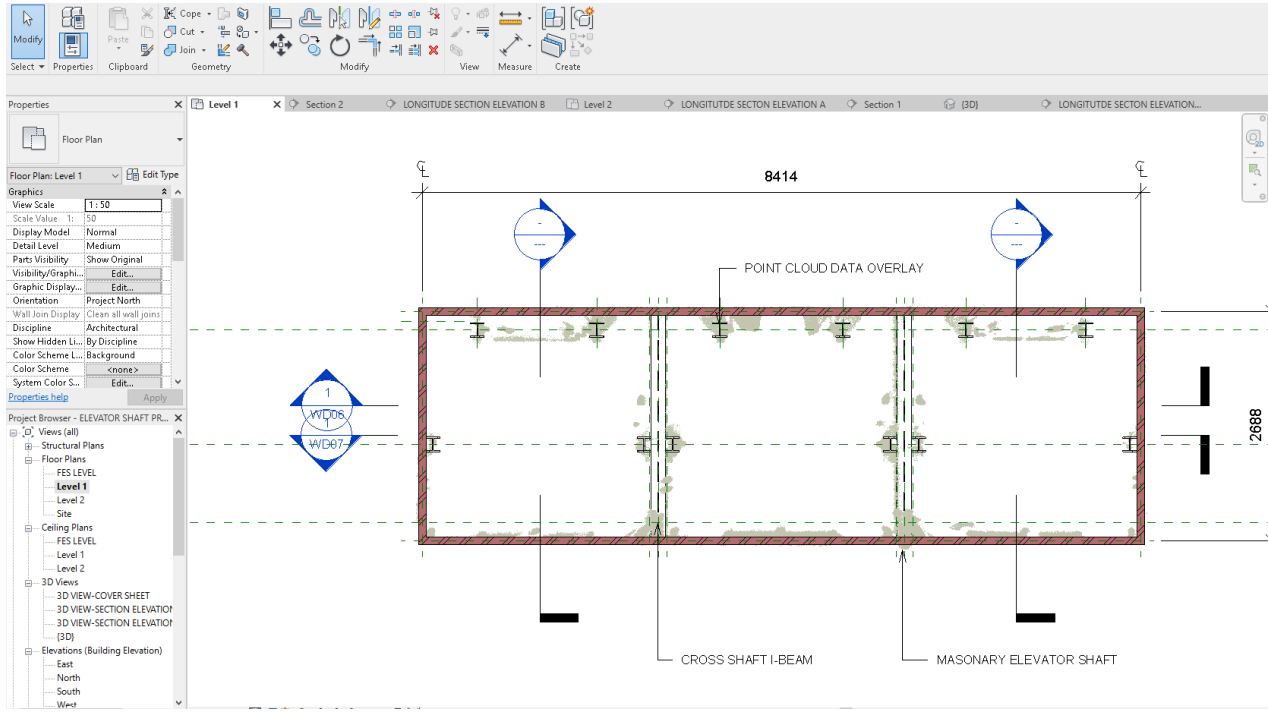


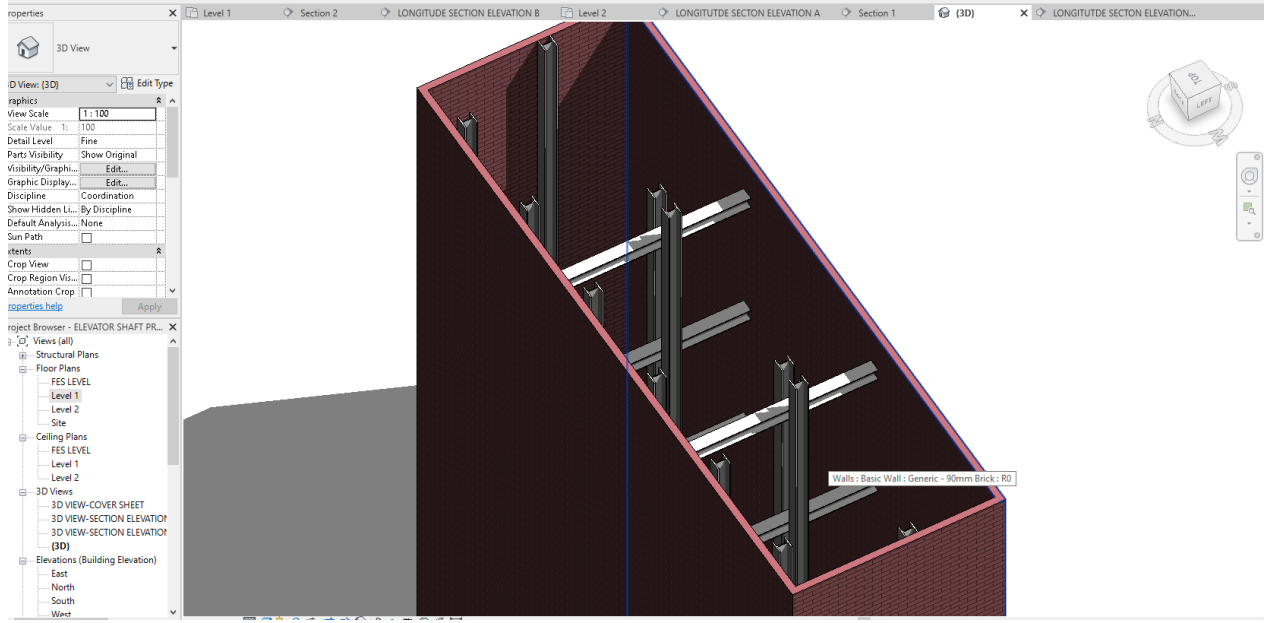
AS-BUILT: ELEVATOR SHAFT

Deliverables

- Revit structural drawings







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